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JOINT COMMAND AND CONTROL: INTEGRATION NOT INTEROPERABILITY

by

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JOINT COMMAND AND CONTROL: INTEGRATION NOT INTEROPERABILITY

by

William B. Apodaca

Lt Col, USAF

A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

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ABSTRACT

While the fundamental nature of war has enduring characteristics, the methods of warfare have evolved. At its essence, war is more art than science. However, the science of war has evolved significantly with the revolutionary advancements in computers and sensors. Command and control (C2) coalesces the art and science of war. It combines and transforms military capabilities into military power. Thus, C2 is inherent in military operations. It is integral not only to Service operations but to operations within each of the functional warfighting domains—air, land, maritime, space and cyberspace.

Currently, the four Services independently fund, field and operate distinct, in effect, stand-alone C2 systems. However, every operational level event is Joint. In order to incorporate their capabilities into Joint operations, the Services have developed distinct C2 systems with various level of interoperability, but none of them are truly integrated. This creates a dilemma whether to continue with C2 systems that are merely interoperable or adopt a different approach.

The Services develop interoperability internally between the computer and communication equipment as part of their distinct systems. But in order for the distinct C2 systems to have any functionality between each of the Services, the Services must develop some degree of interoperability externally between their separate computer and communication equipment. Besides having to engineer interoperability, the Services also must determine the level of interoperability to develop and the particular systems and equipment that will be interoperable. The ability for systems to minimally function together would meet the intent of the definition. However, even the highest level of interoperability would still not achieve full integration.

This thesis argues Joint military operations will never be fully integrated as long as the Services have separate C2 systems. If Joint operations are the benchmark for employing military force in the future, the Department of Defense (DoD) must develop a unified C2 system for the Joint Force Commander (JFC) in order to integrate land, maritime, air, space and cyberspace capabilities across the range of military operations. Currently the JFC's only option is to execute C2 through the different C2 systems of the four Services. The optimal resolution is a single, Joint C2 system that the JFC, Service component and functional component commanders all employ uniformly.

This thesis also argues that DoD must commit to centralized funding of C2 as a solution. Centralized funding will drive the appropriate organization construct that can manage the planning, requirements, development and acquisition of a Joint C2 system. To implement a centralized funding approach, under DoD leadership, the Services should stop funding further development of their current systems and only fund minimal sustainment for the next 5 years. Then DoD should consolidate the funding from the Services and invest in the next generation of a single Joint C2 system. By removing the burden of funding from the Services, DoD can develop an impartial and Joint solution.

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DEDICATION

I dedicate this work to my family. First and foremost to my wife, Oralia, you are the rock of our family. Your support and belief in me have allowed me to achieve more than I could have without you. To my four boys, you have been my inspiration. I strive to be the man and father that you deserve. And I hope you are as proud of me as I am of you. I love you all.

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CHAPTER 1:

Introduction

Why Command and Control?

> No single activity in war is more important than command and control. Command and control by itself will not drive home a single attack against an enemy force. It will not destroy a single enemy target. It will not effect a single emergency resupply. Yet none of these essential warfighting activities, or any others, would be possible without effective command and control.[1]

"Command and control is a process. It is something we *do*."[1] Simply stated, command is authoritative leadership; a commander provides order and direction. While control is management of direction; a commander plans, monitors, assesses and revises his/her direction. However, combining the two, command and control (C2) evolves into a much more comprehensive and complex term that includes people, structures, processes, procedures and systems. Further, C2 is germane to all levels of war and across the range of military operations. It includes every facet of warfare. Because C2 permeates all aspects of Joint operations, the full range and effects of C2 theory are complex and challenging to describe.

While the fundamental nature of war has enduring characteristics, the methods of warfare have evolved. At its essence, war is more art than science. It remains a human endeavor, a clash of wills filled with survival, fear, courage, instinct, cognition, judgment and decision-making. However, it can be argued the science of war has evolved even

[1] U.S. Marine Corps, *Command and Control*, Marine Corps Doctrine Publication 6 (Washington DC: Department of the Navy, October 4, 1996), 52.

more significantly with both the evolutionary and revolutionary advancements in computers, sensors, munitions and weapons platforms.

Command and control coalesces the art and science of war. Like war, "command and control systems have evolved through history, yet the fundamental nature of the command and control process is timeless."[2] Command and control combines and transforms military capabilities into the military element of national power. Thus, C2 is inherent in military operations. It is integral not only to Service operations but to operations within each of the functional warfighting domains—air, land, maritime, space and cyberspace. Commanders employ C2 to combine capabilities into tactical engagements; tactical engagements into operations; operations into campaigns; and finally campaigns into strategy.

Hypothesis

Currently, the four Services independently fund, field and operate distinct, in effect, stand-alone C2 systems. However, almost every operational level event is Joint. Joint Publication (JP) 1, *Doctrine for the Armed Forces of the United States*, states: "The Armed Forces of the United States conduct military operations as a Joint force…The capacity of the Armed Forces of the United States to operate as a cohesive Joint team is a key advantage in any operational environment."[3] Joint Publication 1 further states Joint matters relate to the integrated employment of U.S. military forces in Joint operations,

[2] U.S. Navy, *Naval Command and Control*,Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 11.

[3] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), I-1.

including matters relating to command and control (C2) of Joint operations.[4] In order to command and control their capabilities in Joint operations, the Services develop distinct C2 systems with varying levels of interoperability, but none are integrated.

This creates a dilemma whether to continue with C2 systems that are merely interoperable or adopt a different approach. "Even though it involves no killing, detection, or resupply, C2 is a force multiplier and vital to mission accomplishment. C2 accomplishes the following:

- Gives purpose and direction to military operations.
- Integrates the efforts of subordinate and supporting forces, causing separate activities to achieve coordinated effects.
- Determines force responsiveness and allocates resources.[5]

This thesis argues Joint military operations will never be fully integrated as long as the Services have separate C2 systems. If Joint operations are the benchmark for employing military force in the future, the Department of Defense (DoD) must develop a unified C2 system for the Joint Force Commander (JFC) in order to integrate land, maritime, air, space and cyberspace capabilities across the range of military operations. Joint C2 is the fuel that powers unified action. Currently the JFC's only option is to execute C2 through the different C2 systems of the four Services. The optimal solution would be a single, Joint C2 system that the JFC, Service component and functional component commanders all employ uniformly.

Joint Publication 3-0, *Joint Operations*, explains the six Joint functions: Command and Control; Intelligence, Fires, Movement and Maneuver, Protection, and

[4] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), I-1.

[5] U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual 6-0 (Washington DC: Department of the Army, August 11, 2003), 1-3.

Sustainment.[6] Because the Services possess capabilities in each of the Joint functional areas, the Joint functions are intended to reinforce and complement one another. As such, integration across the functions is essential to mission accomplishment.[7] However, Joint operations are more than linear operations. During Joint operations military commanders must be able to simultaneously synchronize the functions across multiple domains. Currently, the distinct C2 systems have a visual display of the common operating picture (COP) for a particular domain, so commanders can synchronize the functions within a particular domain. Without a synthesized COP from a single C2 system, commanders do not have the same visual display of a synthesized COP of all domains. The time and effort expended to gain situational awareness across all domains by verbally and/or mentally synthesizing the different COPs is contrary to the fundamental objective of C2.

Scope of Research

Command and control is an extensive subject; too broad for this thesis. Therefore, narrowing the hypothesis to the development of a single C2 system for the Joint team is realistic and practical. However, narrowing the subject creates several issues. First, in order to gain a level of understanding of the subject that will lead to logical recommendations and conclusions, this thesis must provide sufficient substantiation. Specifically, this thesis will provide a review, albeit condensed, of Service doctrine, processes and systems. Secondly, the limited depth of discussion risks implying (or the reader inferring) the solution is more straightforward than reality would

[6] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), III-1.

[7] Ibid.

otherwise dictate. Rather the main purpose is to provide a starting point, an initial proposal, worthy of further study. Finally, because of the extensive nature of C2, this thesis will outline the areas that will and will not be discussed in order to avoid confusion or misunderstanding of expectations.

Foremost, this thesis will draw on doctrine to provide definitions for terms such as command, control and command and control. This thesis will also use doctrine to reinforce, explain or expand on ideas including C2 systems and echelons of command of each of the Services (Air Force, Army, Navy and Marine Corps, but not the Coast Guard). This work will also discuss the warfighting function of C2 and how mission command, decision-making, and information management are inherent concepts of C2.

Equally important is the discussion of the areas that are not addressed in this thesis. While C2 shares common ground with strategy development and planning, this thesis will not discuss either of those processes. However in Chapter 5, this thesis will use the planning process only to illustrate how related processes should be used to implement a recommended C2 acquisition strategy. This thesis will not discuss in detail the command hierarchy except to show where the C2 systems are incorporated in the JFC hierarchy. Subsequently, it will not address the administrative and operational command authorities or relationships such as: Administrative Control (ADCON); Combatant Command (COCOM); Operational Control (OPCON); or Tactical Control (TACON). Nor will it not make recommendations for the 'block and wire' diagrams of command hierarchy especially the changes to C2 doctrine associated with operations in Iraq and Afghanistan. Finally, this work will not compare or evaluate by cost, effectiveness,

efficiency or any other criteria, the Service C2 software applications. Ultimately, these areas are not directly or extensively related to the scope of the hypothesis.

This thesis has an uncomplicated organization. Chapter 2, Background, begins by providing the doctrinal definitions and amplification of key terms and concepts and postulates that C2 is the interaction between three elements: people, systems and processes. The chapter continues with explanations of the Observe, Orient, Decide and Act (OODA) Loop decision-making model developed by Air Force Colonel John Boyd, and the Cognitive Hierarchy, an information/knowledge continuum model. Chapter 3, Service Command and Control Systems, is a concise review of the Joint Task Force (JTF) command hierarchy and subsequent discussion of the C2 systems associated with the Service components. The aim of Chapters 2 and 3 is to develop a baseline understanding of C2 and aspects relevant to this thesis.

Building on this foundation, Chapter 4, Future Command and Control System, begins to develop the case for a single C2 system. This chapter illustrates the interaction between the three elements within a C2 system, of which 'people' are the most important element. Within a large military organization, like a JTF, there are numerous, simultaneous interactions—vertically in the chain of command and horizontally with different units. Therefore a C2 system must provide a visual display, or COP, that creates shared situational awareness throughout a command structure.

The final chapter makes the recommendation for a single C2 system. It starts with a distinction between 'interoperability' and 'integration' while postulating that all the discussion in the preceding chapters, including concepts and doctrine, still apply to the recommendation of single C2 system. The conclusion discusses implications for

requirements and solutions across doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF). And finally, the concept of a single C2 system is not limited to the Department of Defense, but can and should be the model for a whole of government C2 system.

CHAPTER 2:

Background

Doctrinal Terms Defined

In order to establish a foundation of discussion, it is important to understand the purpose of military doctrine. Joint Publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms*, defines doctrine as "fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives."[1] The library of Joint and Service doctrine documents and publications articulate the set of ideas of how to employ military capabilities. The employment of military capabilities is not limited to combat, but the full range of military operations (ROMO) from humanitarian assistance to nuclear war. Doctrine is neither rules nor checklists that are meant to remove the human element from military operations. Rather doctrine is approved guidance for the best use of military capabilities, and while authoritative, it ultimately requires a commander's judgment to determine a particular course of action.

To develop the foundation of discussion on the subject of command and control, it is also important to first examine the terms of 'command' and 'control' separately. Joint Publication 1-02 defines command as "the authority that a commander in the armed forces lawfully exercises over subordinates by virtue of rank or assignment."[2] This definition is used consistently throughout Joint and Service doctrine. Implicit in the definition is that military commanders make decisions and provide direction to those

[1] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 95.

[2] Ibid, 53.

subordinates assigned under his/her purview. Joint force commanders and functional component commanders have different authorities depending on the level and scope of command. Regardless of the level or scope of command, a commander's authority can range from making decisions about administrative functions to providing direction on combat actions to those subordinates assigned under his/her command.

The Joint definition of control, "the authority that may be less than full command exercised by a commander over part of the activities of subordinate or other organizations,"[3] is insufficient to fully understand the term. The definition narrowly addresses a subordinate Service or functional commander's control authorities, such as operational control (OPCON), tactical control (TACON), or administrative control (ADCON). While combatant commanders have combatant command (COCOM) authority, subordinate Joint force commanders and Service component commanders only have OPCON and/or TACON authorities for those forces assigned to their respective commands. Simply stated, Service component commanders have administrative control authority while functional component commanders have control authorities related to combat.

Another aspect of control is that a commander can exercise some limited measure of control over the actions of individual subordinates, but he/she certainly cannot exercise control over the enemy, terrain, weather or any of the other infinite aspects of the combat situation and environment. However, commanders can reasonably expect to gain an understanding of the situation and make timely decisions in order to exert a range of control. They will be able to directly influence, and therefore control, some aspects. For

[3] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 66.

example, in tactical combat engagements, commanders provide direction that compels subordinates to close with and engage the enemy, or operational commanders exert control on tactical battles by synchronizing troop movements, but commanders cannot control the individual actions of each and every subordinate.

The definitions and discussion of 'command' and 'control' provide some context. Separately neither provides the appropriate level of meaning gained from the combination of both words into a single term, 'command and control.' To advance the understanding, the discussion must expand to include the definition of command and control (C2). Joint Publication 1-02 defines 'command and control' as "the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission."[4] This definition still contains the authority derived from 'command' and the direction derived from 'control.' However, the definition also includes mission accomplishment.

Combining the two terms into a single term—command and control—results in a more complex theory of C2. The complexity is not easily explained nor understood. It is an overarching term that includes definitions, terminology, doctrine, principles, operations and systems. It also includes the simultaneous interactions of multiple commanders at different levels and their associated guidance, decisions and direction to subordinates which are all inherent to Joint operations. Finally, the interactions between the individual commanders, or the human element, add to the complexity.

The C2 processes, operations, and systems must help resolve, not add to, this complexity. In order to operate in this complex environment, commanders and operators

[4] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 53-54.

must use standard C2 doctrine that includes definitions, terminology and principles. Service doctrine includes terminology and principles that are needed to command and control their distinctive capabilities, while Joint doctrine includes those principles that are common to all the Services. As Joint Publication 3-0, *Joint Operations*, states: "Some functions, such as C2 and intelligence, apply to all operations."[5] For example, Joint Publication 1, *Doctrine for the Armed Forces of the United States*, outlines nine Principles of War, including Unity of Command. Similar to C2, unity of command means that all forces operate under a single commander who has the authority to direct forces in pursuit of a common purpose.[6] Further, Air Force Doctrine Document 6-0, *Command and Control*,[7] and Naval Doctrine Publication 1, *Naval Warfare*,[8] both include Centralized Control and Decentralized Execution as a key tenet of C2 doctrine. This tenet delineates the interaction between the commander, who provides direction, and the subordinates, who execute that direction.

Joint Publication 1-02 expounds on the definition of C2: "Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of

[5] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), III-1.

[6] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), V-1.

[7] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 5.

[8] U.S. Navy, *Naval Warfare*, Naval Doctrine Publication 1 (Washington DC: Department of the Navy, March 1, 2010), 35.

the mission."[9] This supplementary component of the definition contains several additional elements of C2 theory. Specifically, one important aspect of this definition is 'command and control functions.' Joint Publication 3-0 states: "Joint functions are related capabilities and activities grouped together to help JFCs integrate, synchronize, and direct Joint operations."[10] As such, C2 is more than doctrine. It includes functional tasks that integrate a commander's direction with his/her subordinates' actions. Specific tasks in Joint Publication 3-0 highlight the importance of C2 responsibilities:

- Prepare and, when required, modify plans, orders, and guidance.
- Assign tasks and operational areas as needed.
- Prioritize and allocate resources.
- Communicate and maintain the status of information.[11]

The Role of Human Interaction

As the above tasks emphasizes, C2 requires human interaction. Human interaction within a C2 structure has two levels of interaction. First C2 is the interaction between a commander and his/her subordinates. However, C2 structures in Joint operations are much more complex. Hierarchical C2 structures will have various command levels and some of those levels will have multiple commanders. These complex C2 structures will have multiple, simultaneous interactions from one level to the next as well as within each level. Therefore, C2 theory and doctrine must be able to cope with these multiple interactions that occur simultaneously throughout C2 structures of varying degrees of complexity.

[9] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 53-54.

[10] U.S. Joint Chiefs of Staff, *Joint Operations,* Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), III-1.

[11] Ibid, III-2.

Marine Corps Doctrine Publication (MCDP) 6, *Command and Control*, outlines a model for the interaction between the commander and subordinates. As depicted in Figure 2-1, this model compares a typical view with a Marine Corps view of C2 interaction. The typical view, on the left, illustrates 'command' and 'control' as downward commander guidance. While the Marine Corps view, on the right, illustrates 'command' as downward guidance, but 'control' as reciprocal feedback. MCDP 6 further explains that 'control' in the form of feedback is the mechanism that allows commanders to understand the changing environment and provide additional, subsequent 'command' guidance. Command and control is thus an interactive process involving all the parts of the system working in all directions.[12]

[12] U.S. Marine Corps, *Command and Control*, Marine Corps Doctrine Publication 6 (Washington DC: Department of the Navy, October 4, 1996), 40.

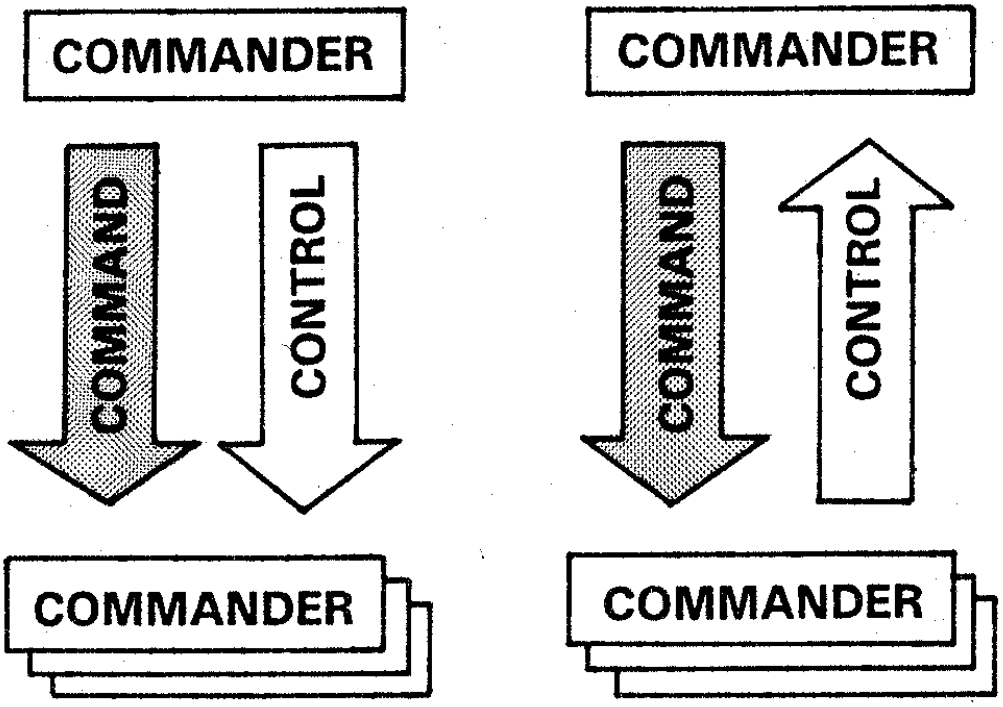

Figure 2-1. Two views of command and control interaction models.[13]

The Marine Corps model depicts the vertical interaction from one level to the next, but does not account for the horizontal interaction within each level. Air Force Doctrine Document (AFDD) 6-0, *Command and Control*, outlines a model that captures both the vertical and horizontal interaction.

[13] Ibid, 41.

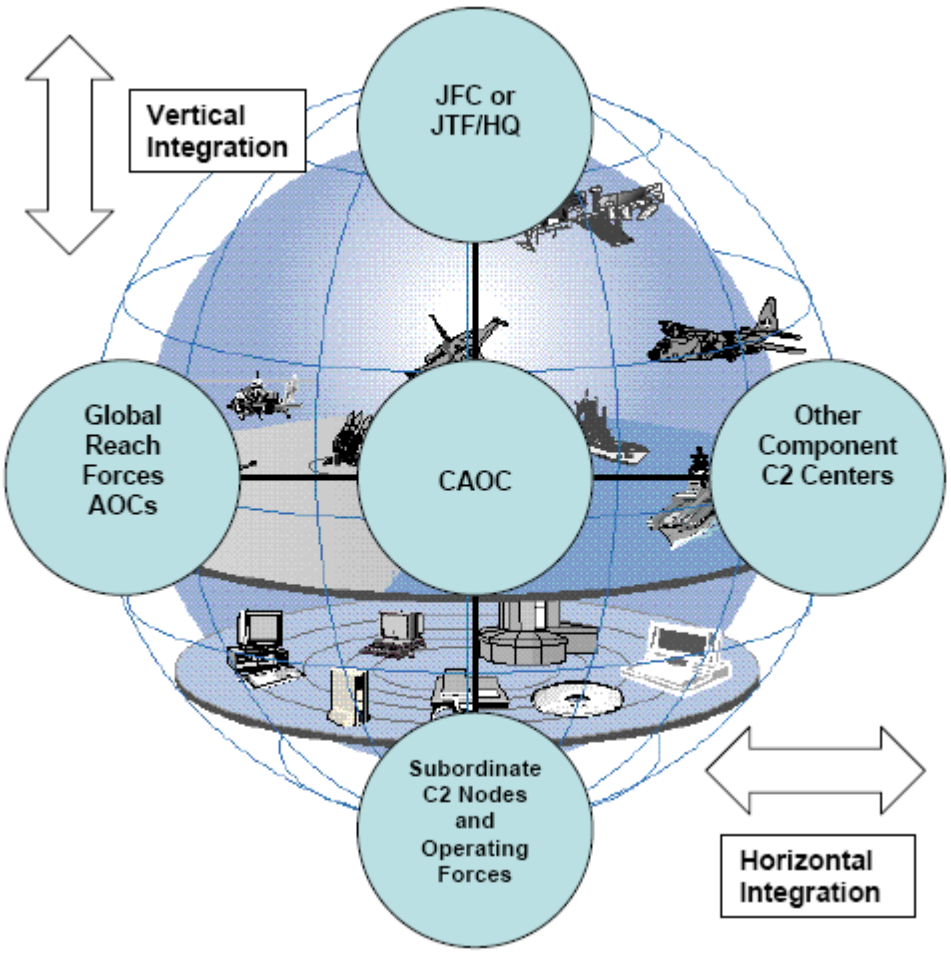

Figure 2-2. Information Integration.[14]

As depicted in Figure 2-2, complex C2 structures have both vertical and horizontal interaction. Through vertical interaction, a commander's direction can directly affect several commanders at multiple lower levels simultaneously. And through horizontal interaction, a commander's direction can indirectly affect other commanders within the same level. For example, vertical interaction is when the Joint Force Commander (JFC) tasks the Joint Force Air Component Commander (JFACC) to provide close air support to ground forces. Using the same example, horizontal interaction is

[14] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 21.

when the JFACC subsequently tasks different subordinate commanders to provide close air support to several ground commanders who are not under the JFACC's command, but under the command of the Joint Force Land Component Commander (JFLCC). These uncomplicated examples are used to illustrate the vertical and horizontal interaction within complex C2 structures, not to over simplify the amount of interaction between commanders in Joint operations.

As depicted in Figure 2-3, a basic premise of this thesis is a C2 structure comprises the interaction of three elements—people, processes and systems. The discussion thus far covered the interaction of only two elements—people and processes. But the definition of C2 also includes a third element, systems or the equipment, communications and facilities.

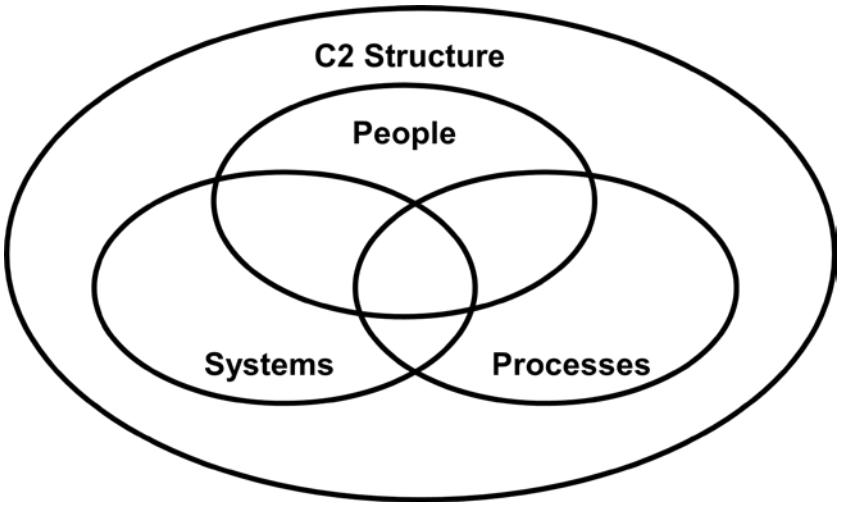

Figure 2-3. Elements of Command and Control.

Command and control systems can facilitate interaction between the elements in three ways: between people and systems; between processes and systems; and between people and processes. The interaction between people (not just C2 operators) with the C2 systems has many facets. For example, people must be able to easily manipulate and

customize the system displays; the information must have standards of format, context and presentation; and the information must be logically organized, readily accessible and easily understood. Examples of the interaction of C2 systems and processes include: the system software can incorporate processes that are Joint, common among several Services or unique to a particular Service; the system can automate processes on a routine or recurring basis; and the system should have an updatable, historical database that can be utilized by the automated processes or through human actions. Finally, C2 systems can facilitate the interaction between people and processes by automating search functions for specific information in internal and external databases; and incorporating multiple communication mediums internally within an operations center and externally to other operations centers and agencies.

Decision Making and Cognitive Hierarchy Models

With this foundational understanding of C2, a perceptive question would be: Why is C2 so important to Joint operations? C2 is much more than people, processes and systems. It is the connective mechanism for Joint operations where the interaction of the three elements is greater than the sum of their individual parts. First recall from the previous discussion that in the doctrinal definition, C2 includes mission accomplishment. During Joint operations, commanders must simultaneously integrate and synchronize many capabilities from the Services across multiple domains to accomplish their missions. Also recall from the previous discussion that Joint doctrine outlines the C2 functional tasks. Predictably, Joint Publication 3-0 includes specific C2 functional tasks which highlight the importance of mission accomplishment:

- Assess progress toward accomplishing tasks, creating conditions and achieving objectives.
- Coordinate and control the employment of Joint lethal and nonlethal capabilities.[15]

Commanders use the C2 structure to accomplish the mission and achieve objectives in two fundamental ways: decision making and information/knowledge management. In *On War*, Clausewitz discusses three elements of war—chance, uncertainty and friction—that affect human decision-making and knowledge. First, he says, "No other human activity is so continuously or universally bound up with chance."[16] On uncertainty, he states, "War is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of greater or less uncertainty."[17] And on friction, he notes, "Everything in war is very simple, but the simplest thing is difficult. The difficulties accumulate and end by producing a kind of friction that is inconceivable unless one has experienced war. Friction is the only concept that more or less corresponds to the factors that distinguish real war from war on paper."[18] Of the three C2 elements, information management is impacted most by systems and processes, while decision-making is impacted most by people, or the human element. As Army Field Manual (FM) 6-0, *Mission Command: Command and Control of Army Forces*, states, "The most important dimension of the C2 environment is the human dimension."[19] Further, Marine Corps Doctrine Publication (MCDP) 1,

[15] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), III-2.

[16] Carl Von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Peret (Princeton, NJ: Princeton University Press, 1989), 85.

[17] Ibid, 101.

[18] Ibid, 119.

[19] U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual 6-0 (Washington DC: Department of the Army, August 11, 2003), 1-9.

Warfighting, provides the following summary of the nature of war: "We thus conclude that the conduct of war is fundamentally a dynamic process of human competition requiring both the knowledge of science and the creativity of art but driven ultimately by the power of human will."[20]

The conduct of war through command and control is too complex to be narrowly explained by decision-making and information/knowledge management. However, both aid the foundational discussion of C2 as a Joint function. C2 is the structure that commanders use to lead and manage forces in complex combat environments. Within the C2 structure, commanders need a methodology for decision-making. Figure 2-4 represents one decision-making model, Colonel John Boyd's Observe, Orient, Decide, and Act (OODA) Loop. As Robert Polk points out in his thesis, *A Critique of the Boyd Theory—Is it Relevant to the Army?*, "Most of the Services incorporated his (Boyd's) four-step model into their doctrine simply to help describe the military command and control process."[21]

[20] U.S. Marine Corps, *Warfighting*, Marine Corps Doctrine Publication 1 (Washington DC: Department of the Navy, June 20, 1997), 19.

[21] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," (Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999), 4.

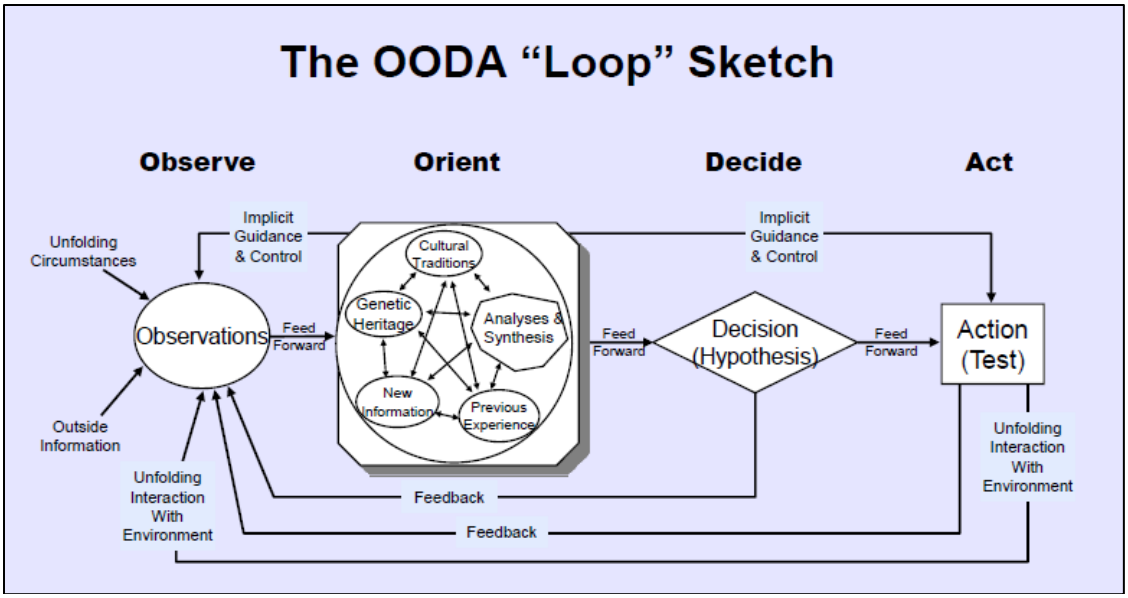

Figure 2-4. Boyd's OODA Loop[22]

Boyd initially developed his OODA loop as a decision-making model using the metaphor of an air-to-air combat engagement. "This metaphor exemplifies the idea of operating at a faster tempo to 'get inside the OODA time cycle or loop' of an adversary."[23] The model's effectiveness depends on how accurately and quickly 1) each step can be accomplished, 2) the entire cycle can be accomplished and 3) the cycle can be continuously repeated. As depicted in Figure 2-4, each step progresses to the next through all four steps until the entire loop is completed. During the Observation step, the commander will examine outside information and unfolding circumstances. The Orientation step is an analyses and synthesis of the information from the Observation step using a variety of factors such as cultural traditions, genetic heritage, previous experience and new information. From the Orientation step, the commander makes a Decision, and then provides direction and guidance that leads to Action. The two Feedback arrows

[22] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," (Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999), 14.

[23] Ibid, 19.

from the Decision and Action steps, back to the Observation step, represent the cyclic characteristic of the loop itself. Note the two components of the loop as depicted by the outermost arrows—Implicit Guidance and Control and Unfolding Interaction with the Environment—are developed further in Chapter 4.

The OODA loop provides a framework for understanding how decisions are made and the confrontational nature of opposing decision-making cycles in warfare. The model itself will not ensure a commander will make faster or better decisions than the adversary. Neither will the model guarantee the resultant actions implemented from their decisions will lead to success in battle because many aspects of warfare are either unpredictable or beyond a commander's control.

Joint and Service doctrine documents discuss the relationship of decision-making to command and control. As Naval Doctrine Publication 6 states, "Our efforts to establish effective command and control are shaped by two fundamental factors that define the environment of command and control in every military operation—uncertainty and time."[24] Command and control structures and systems are the mechanisms that commanders use to cope with uncertainty and time constraints as they make decisions and take action. As previously discussed, the OODA loop is not only a decision-making model, but it also highlights the importance of time to the task of making the decision. So it is the interaction of another model that makes the discussion of a decision-making model, like the OODA loop, more applicable to C2.

As depicted in Figure 2-5, the Cognitive Hierarchy is a useful model that Joint and Service doctrine describe as either information management or knowledge

[24] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 11.

management. This particular model shows the hierarchy continuum from data to information, then knowledge and ultimately understanding. While understanding is the ideal cognitive state, in reality commanders, especially in combat situations, will be required to make decisions along the entire continuum.

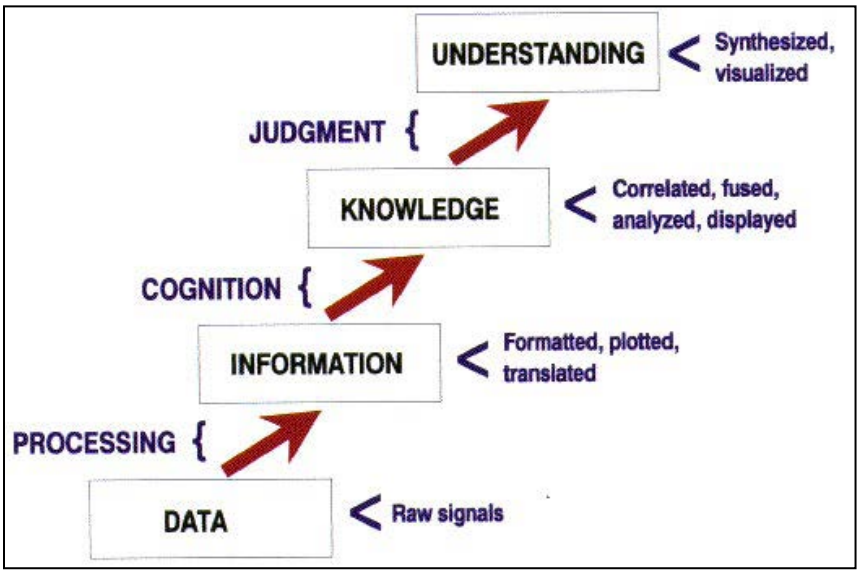

Figure 2-5. The Cognitive Hierarchy[25]

Army Field Manual (FM) 6-0, *Mission Command*, explains the progression from data to understanding (italics added).

> *Data* consists of unprocessed signals or sensing from the environment. Data can be quantified, stored, and organized in files and databases. However, to make data useful, people must process it into information. *Information* is the meaning that a human assigns to data. Information alone rarely provides an adequate basis for deciding and acting. *Knowledge* is information analyzed to provide meaning and value or evaluated as to implications for the operation. Generally, knowledge is the result of individual cognition. Finally, *understanding* is knowledge that has been synthesized and had judgment applied to it to comprehend the situation.[26]

[25] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 21.

[26] U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual 6-0 (Washington DC: Department of the Army, August 11, 2003), A-1, A-2.

Because of the uncertainty of war and the tempo of combat, it will be rare, and probably not achievable, for a commander to collect all the relevant variables of data, completely reduce uncertainty, and achieve true understanding in a combat environment. As Navy doctrine outlines, "We try to reduce uncertainty to a reasonable point by gathering information, which we can transform into knowledge and understanding. Nevertheless, the nature of combat always will make absolute certainty impossible to attain."[27] This is not to marginalize the Cognitive Hierarchy model, but rather to stress its importance to the OODA loop. Figure 2-6, further illustrates the complexity of the Cognitive Model and the effect on uncertainty during the Orientation phase.

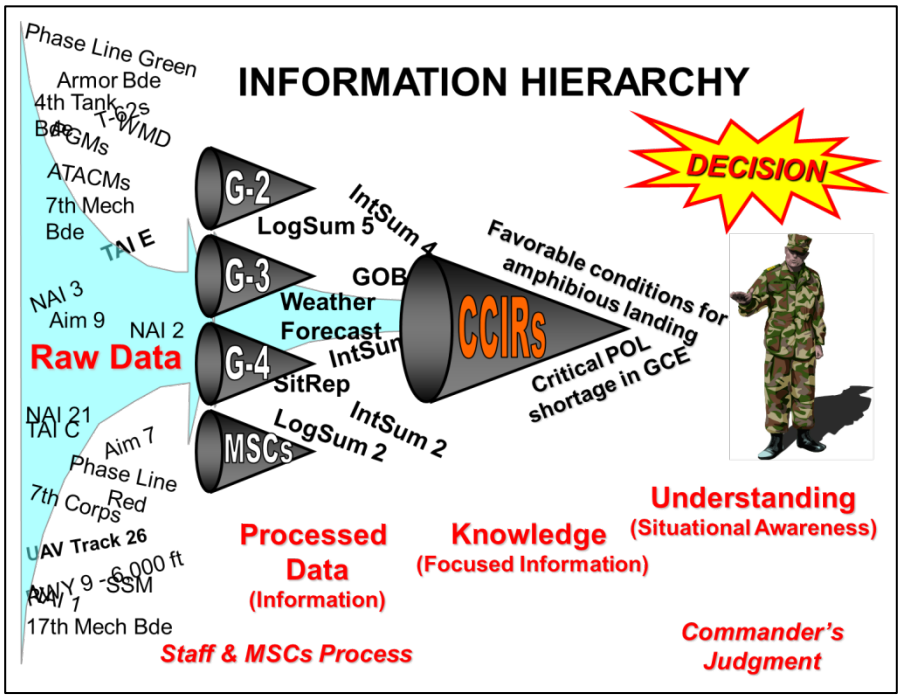

Figure 2-6. The Information Hierarchy

[27] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 12.

Notably, Colonel Boyd considered Orientation as the critical phase of the OODA process.[28] "In general, we base our decision making on our orientation to the situation. Orientation is the result of a cognitive process that turns data gathered from the environment into knowledge and understanding. It is the key to the entire decision and execution cycle, because it influences the way we observe, decide, and act."[29] Simply stated, the cognitive hierarchy creates situational awareness during orientation phase of the OODA loop model.

The key point is that "making sound and timely decisions is a key objective of the command and control process,"[30] and the ultimate goal is to achieve decision superiority through informed decision-making. The interaction between the cognitive hierarchy and OODA loop models supports this objective. As AFDD 3-13, *Information Operations*, states, "Decision superiority is a competitive advantage, enabled by an ongoing situational awareness, that allows commanders and their forces to make better-informed decisions and implement them faster than their adversaries can react. Decision superiority is about improving our ability to observe, orient, decide, and act (OODA loop) faster and more effectively than the adversary."[31]

[28] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," (Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999), 23.

[29] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 19.

[30] Ibid, 23.

[31] U.S. Air Force, *Information Operations*, Air Force Doctrine Document 3-13, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 1.

CHAPTER 3:

Service Command and Control Systems

Joint Force C2 Structure

Along with the authority and responsibility, commanders must have the ability to command and control (C2) their forces and capabilities. In the Joint structure of the Department of Defense, the responsibility to develop C2 systems currently resides with the Services. The primary reasons are both functional and monetary. Functionally, the warfighting responsibility belongs to the geographic Combatant Commanders (CCDR). In accordance with Joint doctrine, the CCDR can establish a Joint Task Force (JTF) that includes a Joint Force Commander (JFC), functional component and Service component commanders as depicted in Figure 3-1. Joint Publication 3-33, *Joint Task Force Headquarters,* states, "CJTFs may normally establish functional component commands to control military operations. A functional component command typically consists of forces of two or more Military Departments established to perform designated missions."[1]

[1] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations,* Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), xii.

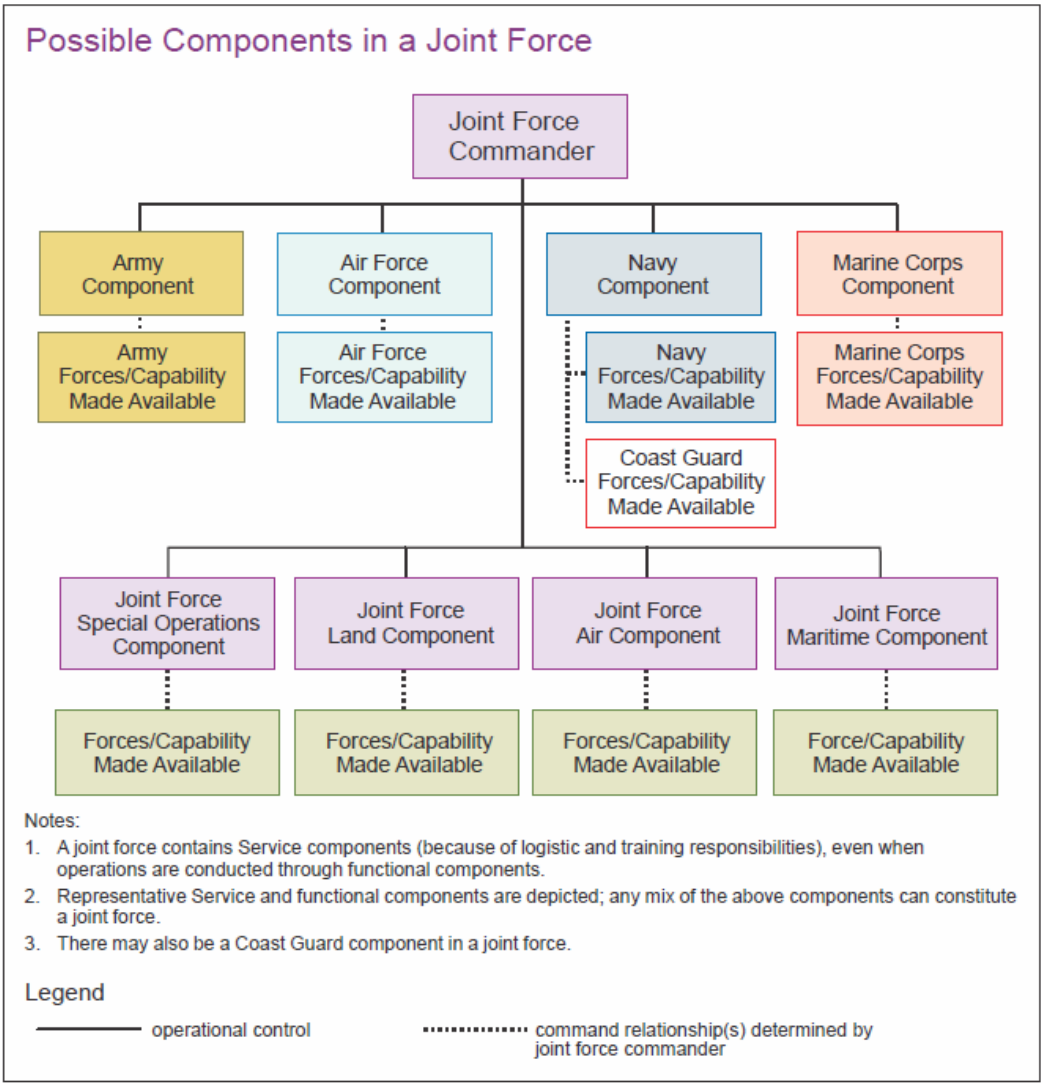

Figure 3-1. Components in a Joint Force.[2]

Monetarily, the Services, through United States Code Title X authority, have the responsibility and control of their budgets to organize, train, equip and provide forces to the geographic CCDRs. Within the JTF structure, Service component commanders retain their Service responsibilities, including the responsibility to provide C2 systems, facilities and personnel. According to Joint Publication 3-33, "The preferred approach to forming a JTF HQ is to do so around an existing C2. Typically this is a CCMD's Service

[2] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), IV-3.

component HQ or a subordinate Service component HQ."[3] The consequence of this approach is the warfighting commanders, the CCDR and the JFC, rely on the Services to provide their Service-specific C2 systems to the JFC's C2 structure. Joint Publication 3-33 also notes, "Normally, the Service component commander with the preponderance of forces to be tasked and the ability to C2 those forces will be designated as the functional component commander."[4]

To limit discussion, this thesis will address the C2 used by the four JTF Service components—Air Force (AFFOR), Navy (NAVFOR), Army (ARFOR), and Marine Corps (MARFOR)—and when designated, the three JTF functional components—the Joint Force Air Component Commander (JFACC), the Joint Force Maritime Component Commander (JFMCC) and the Joint Force Land Component Commander (JFLCC). Each of these commanders will establish unity of command and unity of effort for Joint air, maritime and land operations[5] at the operational level of war. However, their C2 structures and systems have both similarities and differences. Although the discussion is limited to the JTF-level commanders, the recommendations and thoughts apply horizontally at the operational-level to the geographic and functional combatant commands as well as the sub-JTF commanders and task force components. Additionally, the thoughts and recommendations also apply vertically to the strategic levels of war above the JTF and to the lower tactical level below the functional and Service component commanders.

[3] U.S. Joint Chiefs of Staff, *Joint Task Force Headquarters*, Joint Publication 3-33 (Washington DC: Joint Chiefs of Staff, July 30, 2012), II-1.

[4] Ibid, III-4.

[5] Ibid, III-4 - III-5.

As stated above, C2 is a responsibility of the Service component commander and transferred to the functional component commander. To illustrate this point, each of the Service commanders has an organic system designed for C2 of their air operations as outlined in Joint Publication 3-30, *Command and Control for Joint Air Operations*: the Air Force's theater air control system (TACS), the Navy tactical air control system (NTACS), the Army air-ground system (AAGS) and the Marine air command and control system (MACCS). Together these systems are known as the Theater Air Ground System (TAGS).[6]

Air Force C2 Systems

As depicted in Figure 3-2, the TACS is composed of airborne and ground-based C2 elements. Airborne elements are the Airborne Warning and Control System (AWACS) and the Joint Surveillance Target Attack Radar System (JSTARS). The ground elements are the Air and Space Operations Center (AOC), Control and Reporting Center (CRC), Air Support Operations Center (ASOC), and Tactical Air Control Party (TACP).[7] The CRC and AWACS provide C2 for air operations while the ASOC, TACP and JSTARS provide C2 for air operations directly supporting ground forces.

[6] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-9.

[7] U.S. Air Force, *AF Instruction 13-1AOC, Volume 3: Operational Procedures-Air Operations Center (AOC)*, Incorporating Change 1, May 18, 2012, (Washington DC: Department of the Air Force, November 2, 2011), 10.

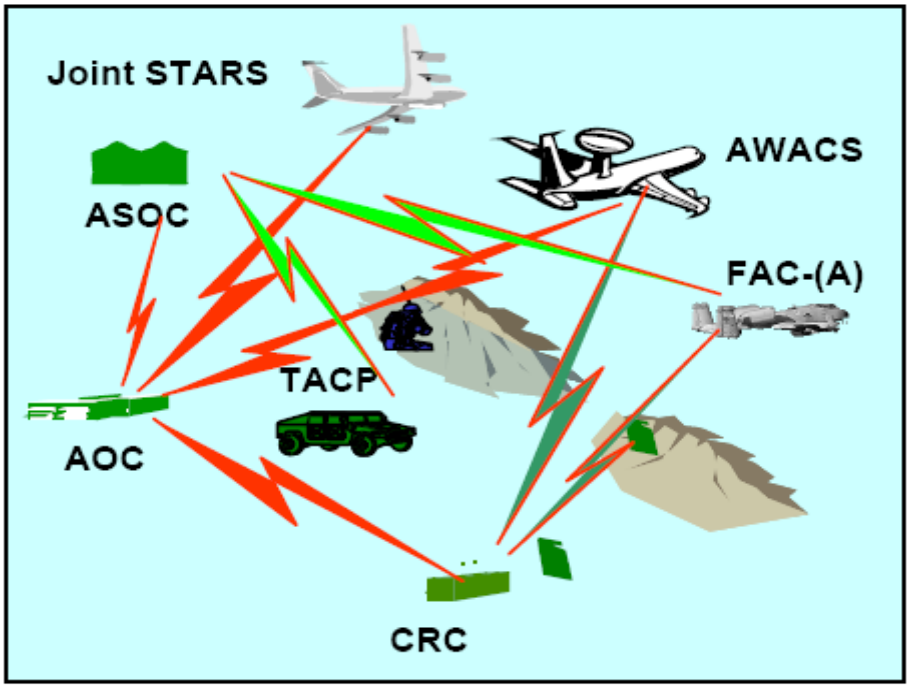

Figure 3-2. Theater Air Control System.[8]

Air Force Doctrine Document (AFDD) 6-0, *Command and Control*, states, "The AOC is the senior element of the TACS. The TACS can be tailored to support contingencies ranging from the smallest stability operation to full scale combat operations."[9] No matter the size and scale of the TACS, "the AOC coordinates closely with superior and subordinate C2 nodes, as well as the headquarters of other functional and Service component commands to integrate the numerous aspects of air, space, and cyberspace operations to accomplish its mission."[10] The other components integrate with Air Force C2 by assigning a selection of functional, Service and specialty liaisons to the AOC as needed. The liaisons coordinate, integrate and synchronize their capabilities and

[8] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 64.

[9] Ibid.

[10] U.S. Air Force, *AF Instruction 13-1AOC, Volume 3: Operational Procedures-Air Operations Center (AOC)*, Incorporating Change 1, May 18, 2012, (Washington DC: Department of the Air Force, November 2, 2011), 10.

requirements into the air campaign. For example, "the battlefield coordination detachment (BCD) represents the Army, while the naval and amphibious liaison element (NALE) articulates Navy and Marine interests, unless a separate Marine liaison officer (MARLO) is designated."[11] Additionally, the COMAFFOR (or JFACC) will likely establish air component coordination elements (ACCE) in the JTF headquarters to integrate air and space operations within the Joint force and in the other component headquarters to integrate air and space operations with land and maritime operations.[12]

According to Joint Publication 3-30, "The TACS is the commander, Air Force forces (COMAFFOR) mechanism for commanding and controlling component air and space power."[13] Further, AFDD 6-0, *Command and Control*, states, "The COMAFFOR requires the ability to provide command and oversight of Air Force forces offered up to the Joint or combined operation. The COMAFFOR's C2 system should be interoperable, horizontally integrated across functions, vertically integrated across all echelons of command, and provide organizational connectivity between commanders and decision makers down to the employing units."[14] First, this thesis argues use of the terms 'interoperable' and 'integrated' as used in the above statement is incorrect, and the correct use of the terms will be discussed later in Chapter 4. Further, the statement does not specifically state the Air Force C2 systems will be interoperable with the C2 systems of the other Services. And the vague use of the term 'interoperable' suggests that C2

[11] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 63.

[12] Ibid.

[13] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-9.

[14] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 39.

systems will have varying levels of interoperability. Theoretically, the Air Force has autonomy to develop which systems will be interoperable and/or integrated and to what level of interoperability and/or integration is appropriate both internally within the Air Force C2 systems and externally with the C2 systems of the other Services.

Navy C2 Systems

As Naval Doctrine Publication (NDP) 6, *Naval Command and Control*, states, "the focus of naval command and control is the commander."[15] Further, "the hallmark of command at sea has been the broad, undisputed authority of the ship's captain."[16] Historically and still today, naval ships operate across vast distances over the open ocean. This operating environment requires quick, independent action by underway commanders based on a senior commander's intent. "This style of command has been an enduring characteristic of naval operations and continues to distinguish the way naval commanders exercise command and control today."[17]

NDP 6 further outlines, "As a system, naval command and control has three components—our command and control organization, information, and command and control support."[18] The Navy organizes the size, forces and capabilities of the fleet, including C2, to support a Joint Task Force (JTF). The JFC will either assign a Service Naval Component Commander (NCC) or functional Joint Forces Maritime Component Commander (JFMCC) to conduct Joint maritime operations in support of the JTF objectives. The Navy has developed a new C2 organization—the Maritime Operations

[15] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 7.

[16] Ibid, 9.

[17] Ibid.

[18] Ibid, 31.

Center (MOC). "MOCs are established at all [numbered] fleets and Navy component command headquarters and form the nucleus of a Joint force maritime component commander (JFMCC) and/or JFC staff when established."[19]

As depicted in Figure 3-4, the MOC is similar in size, scope and mission for the maritime domain as the Air Force AOC is for the air domain. Navy Tactics, Techniques, and Procedures (NTTP) 3-32.1, *Maritime Operations Center,* states "To support the commander's decision-making process and C2 functions, the MOC staff uses boards, bureaus, centers, cells, and working groups (B2C2WG), as well as elements, groups, offices, planning teams, and other coordinating bodies, to support the commander's decision cycle during all phases and across the full range of operations. Organizing the MOC by using B2C2WG to plan and execute assigned missions will greatly speed planning and the decision-making process."[20]

Overall, the MOC provides the NCC/JFMCC a functionally organized staff and C2 system to conduct Joint maritime operations planning, guidance and execution. However, maritime air operations involve a collaborative effort between the MOC, the Joint Air Operations Center (JAOC) and Navy task force commanders and other subordinate staffs.[21] Subordinate to the MOC, the Navy tactical air control system (NTACS) is the principal air control system afloat for tactical amphibious air operations and planning. "The NTACS is comprised of the Navy tactical air control center (TACC), tactical air direction center, and helicopter direction center. The Navy TACC is the

[19] U.S. Navy, *Maritime Operations Center*, Navy Tactics, Techniques, and Procedures 3-32.1 (Washington DC: Department of the Navy, October 2008), 1-2.

[20] Ibid.

[21] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-12.

primary air control agency within the amphibious operations area from which all air operations supporting the amphibious task force are controlled."[22]

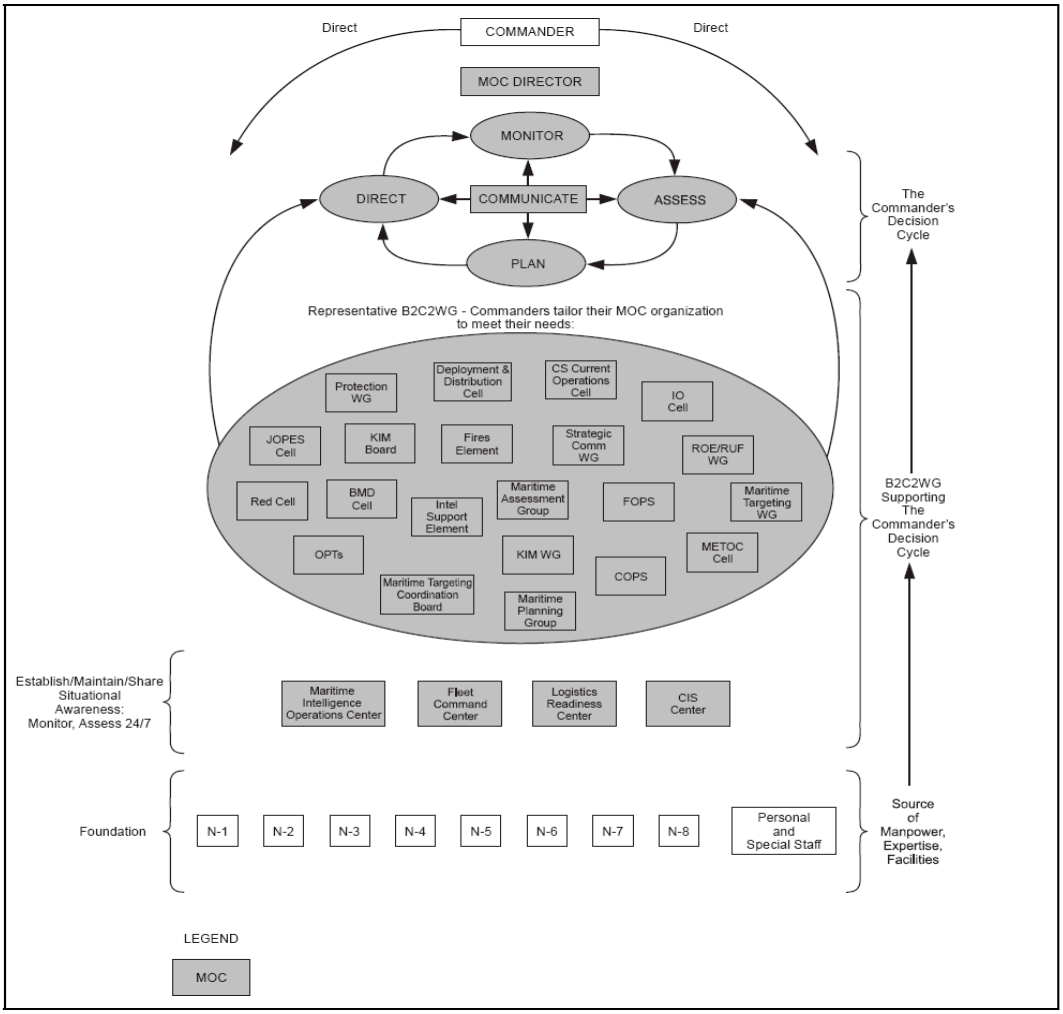

Figure 3-4. Notional Navy Fleet/Component MOC Organization.[23]

[22] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-12.

[23] U.S. Navy, *Maritime Operations Center*, Navy Tactics, Techniques, and Procedures 3-32.1 (Washington DC: Department of the Navy, October 2008), 1-4.

Marine Corps C2 Systems

Marine Corps Doctrine Publication (MCDP) 3, *Expeditionary Operations*, states, "The Marine Air-Ground Task Force (MAGTF) is the Marine Corps' principal organization for all missions across the range of military operations."[24] The MAGTF provides an expeditionary force that can be tailored in size and mission including the JTF commander, MARFOR Service commander, JTF functional commander and Combatant Command levels. MAGTFs are task-organized so regardless of the size or mission, each MAGTF has the same basic structure. As depicted in Figure 3-6, "All MAGTFs consist of four core elements—a command element (CE), a ground combat element (GCE), an aviation combat element (ACE), and a logistics combat element (LCE)."[25] The CE is the MAGTF headquarters including senior command and control element for planning and execution of expeditionary military operations. Additionally, the communication battalion plans and engineers command and control systems and provides "communications and information systems support to MARFOR component headquarters and MAGTF CEs."[26]

[24] U.S. Marine Corps, *Expeditionary Operations*, Marine Corps Doctrine Publication 3 (Washington DC: Department of the Navy, April 16, 1998), 69.

[25] U.S. Marine Corps, *Marine Corps Operations*, Marine Corps Doctrine Publication 1-0. (Washington DC: Department of the Navy, August 9. 2011), 2-6.

[26] U.S. Marine Corps, *Organization of Marine Corps Force*, Marine Corps Reference Publication 5-12D (Washington DC; Department of the Navy, October 13, 1998), 6-20.

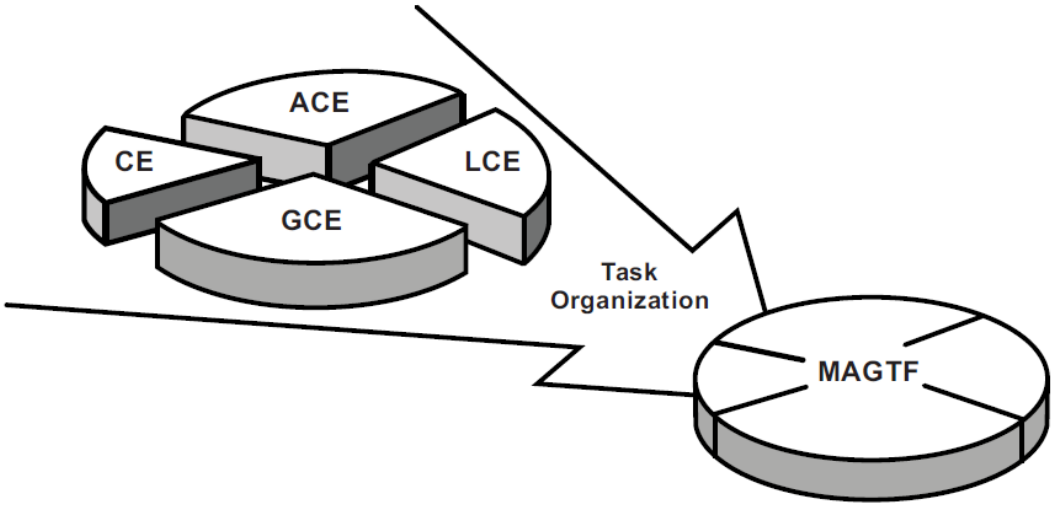

Figure 3-6. Command Structure of the MAGTF.[27]

In addition to the CE, the ACE C2 structure is well defined in Joint and Marine Corps doctrine including how the MAGTF air capabilities interface with the Air Force AOC and Navy MOC. The Marine air command and control system (MACCS) consists of various air C2 agencies designed to provide the ACE commander with the ability to monitor, supervise, and influence the application of Marine aviation.[28] The MACCS has three primary agencies—the tactical air command center (TACC), (not to be confused with the Navy TACC), the tactical air operations center (TAOC), and the direct air support center (DASC).

As Marine Corps Warfighting Publication 3-25.4, *Marine Tactical Air Command Center Handbook*, explains, the TACC is the senior command agency of the MACCS. As the senior command agency, it integrates Marine Corps aviation with the CE through linkage with the MAGTF combat operations center (COC). The TACC "is the

[27] U.S. Marine Corps, *Marine Corps Operations*, Marine Corps Doctrine Publication 1-0. (Washington DC: Department of the Navy, August 9. 2011), 2-7.

[28] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-12.

operational wing command post from which the ACE commander and his staff plan, supervise, coordinate, and execute MAGTF air operations."[29] The TACC "performs similar duties for organic Marine Corps aviation to those that the AOC performs for Air Force component operations."[30] Additionally, the TAOC "is the primary air control agency of the MACCS. TAOC operations parallel those of the CRC normally associated with joint Army and USAF defensive air operations."[31] While the DASC "is the principal air control agency responsible for the direction of air operations that support Marine ground forces. The DASC is roughly equivalent to the Air Force's ASOC."[32]

Army C2 Systems

Of the Services, the Army has made recent and significant changes to command and control doctrine. According to the Army Combined Arms Center's Doctrine Update 1–12, "The 2011 change to Field Manual (FM) 3-0 replaced the Army term and definition of *command and control* with the term and definition of *mission command*." As a result, several of the Army's Mission Command doctrine publications were issued very recently: Army Doctrine Publication (AD) 6-0, *Mission Command*, May 2012; Army Doctrine Reference Publication (ADRP) 6-0, *Mission Command*, May 2012; and (FM) 6-0, *Mission Command*, September 2011. Additionally, the Doctrine Update 1-12 states, "The command and control warfighting function became the mission command

[29] U.S. Marine Corps, *Marine Tactical Air Command Center Handbook*, Marine Corps Warfighting Publication 3-25.4 (Washington DC: Department of the Navy, September 21, 1998), 1-2.

[30] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-12.

[31] U.S. Army, *Battlefield Coordination Detachment*, Field Manual 100-13, Appendix B (Washington DC: Department of the Army, September 5, 1996), B-9.

[32] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-12.

warfighting function. The mission command warfighting function consists of the mission command tasks and the mission command system."[33] Finally, "*Mission command* replaces the Army doctrinal term *command and control*. The former command and control warfighting function is now called the mission command warfighting function—not *command and control* or C2. The function of *command* and the function of *control* are still valid, but not when combined into a single phrase or function. When discussing Army operations, *command and control* (including the shortened form C2) is an obsolete term."[34] While this thesis will not address the concept of mission command, the above changes are significant because much of Army doctrine still uses the terms 'command and control' and 'C2' when referring to command structures and control systems.

The Army (for example 3rd Army) is the theater-level command echelon for the U.S. Army. The Army commander will be the Army's Service component and/or the functional Joint Forces Land Component Commander (JFLCC). The Army headquarters and staff will become the Service and/or functional headquarters in the JTF command structure. Subordinate to Service/functional component headquarters is the Corps headquarters. A Corps is organized as a headquarters element only. A Corps headquarters provides command and control for several Division headquarters as well as direct command of Brigade Combat Teams (BCT) if needed. Like a Corps, a Division is a headquarters element only. "The Division consists of the headquarters elements to

[33] U.S. Army Combined Arms Center, *Doctrine Update 1-12*, Mission Command Center of Excellence (Fort Leavenworth, KS: Department of the Army, December 16, 2011), 6.

[34] Ibid, 8-9.

command and control one to six BCTs and their associated support and sustainment brigades. It is the principal warfighting command and control echelon."[35]

The Brigade is the next level of C2 echelon below the Division. "Heavy, Infantry, and Stryker Brigade Combat Teams are the Army's combat power building blocks for maneuver, and the smallest combined arms units that can be committed independently."[36] As outlined in FM 3-90.6, *Brigade Combat Team*, "BCTs are structured to command and control their operations through two command groups and three primary command posts (CP)—main CP, tactical CP, and brigade support battalion (BSB) CP."[37] The commander's and deputy commanding officer's (DCO) command groups allow them to exercise command and control when they are mobile within the area of operations, at forward positions, or away from the main and tactical CPs. The main CP is primarily responsible for C2 of the BCT and includes representatives of all staff sections, and functional and integrating cells that perform specific functions. The tactical CP is an extension of the main CP specifically assembled to control an operation or task for a limited time period. While the [brigade support battalion] BSB CP controls and coordinates the administrative and logistical support for the BCT.[38] Finally, the Army coordinates Joint fires with the other Services through the Army Air-Ground System (AAGS). "The AAGS provides interface between Army and tactical air support

[35] U.S. Army, *Organization of the US Army (Army 101) Primer*, Army Force Management School (Fort Belvoir, VA: Department of the Army, May 2012), 14-15.

[36] U.S. Army, *Brigade Combat Team*, Field Manual 3-90.6 (Washington DC: Department of the Army, September 14, 2010), 1-1.

[37] Ibid, 1-18.

[38] Ibid, 1-18 – 1-20.

agencies of other Services in the planning, evaluating, processing, and coordinating of air support requirements and operations."[39]

[39] U.S. Joint Chiefs of Staff, *Command and Control for Joint Operations*, Joint Publication 3-30 (Washington DC: Joint Chiefs of Staff, January 12, 2010), II-10.

CHAPTER 4:

Future Command and Control System

Interoperability or Integration?

The previous discussions, first in Chapter 2, regarding command and control (C2) doctrine, the Observe, Orient, Decide and Act (OODA) loop model, and the Cognitive Theory model; then in Chapter 3 regarding the current C2 systems, established a foundational understanding of C2. This chapter advances those ideas and incorporates new ideas with the goal of showing that a future C2 system must be a single system because the distinct systems of the Services inadequately provide C2 to Joint operations. The chapter begins by providing doctrinal definitions of several important terms—system, interoperability, integration and common operational picture (COP)—that are germane to the discussion.

Joint Publication (JP) 1-02, defines 'system' as: "A functionally, physically, and/or behaviorally related group of regularly interacting or interdependent elements; that group of elements forming a unified whole."[1] This definition is consistent and inclusive of the theory of C2 as well as the definitions discussed in Chapter 2. The important distinction, as shown in the discussion of C2 systems in Chapter 3, is the Services historically and primarily regard the term 'system' from a narrow Service-only (if not domain-only) perspective in development of their C2 systems. As outlined, the United States conducts military operations as a Joint force. So, while our fighting doctrine is

[1] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 299.

founded in 'Jointness,' our Services are developing C2 systems that do not support a Joint construct.

Interoperability has two definitions both of which apply to C2. First interoperability is "the ability to operate synergistically in the execution of assigned tasks."[2] This definition applies to the functions of C2 related to individual forces and capabilities operating together. And by definition, the ability to operate together is expected to create synergy. The second part of the definition is, "the condition achieved among communications-electronics systems or items of communications-electronics equipment when information or Services can be exchanged directly and satisfactorily between them and/or their users."[3] Although this paper does not address the computer software and communication equipment associated with C2 systems, this definition includes an important aspect of the hypothesis. The Services develop internal interoperability between the computer and communication equipment as part of their distinct systems. But in order for the distinct C2 systems to have any functionality between each of the Services, the Services must develop some degree of external interoperability between their separate computer and communication equipment. Besides engineering interoperability, the Services also must determine the level of interoperability to develop and the particular systems and equipment that will be interoperable. In fact, Joint doctrine recognizes that the term interoperability has a limitation, as stated in the definition, "The degree of interoperability should be defined when referring to specific

[2] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 157.

[3] Ibid.

cases."[4] In practical application, synergistic operations are not a given outcome of interoperability. For example, the ability for systems to minimally function together would meet the intent of the definition.

However, even the highest level of interoperability would still not achieve full integration. Joint Publication 1-02 defines integration as, "The arrangement of military forces and their actions to create a force that operates by engaging as a whole."[5] Like interoperability, this definition applies to forces operating together. But unlike interoperability, integration combines individual forces to create a force that operates as a whole. From a forces perspective, Service personnel are combined to create a C2 force that employs as a whole. From a systems perspective, "system integration is the successful putting together of the various components, assemblies, and subsystems of a system and having them work together to perform what the system was intended to do."[6] Air Force Doctrine Document (AFDD) 1 summarizes the depth of integration as it relates to C2: "C2 involves the integration of the systems of procedures, organizational structures, personnel, equipment, facilities, information, and communications designed to enable a commander to exercise command and control across the range of military operations."[7]

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[4] Ibid.

[5] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 151.

[6] U.S. Air Force, Software Technology Support Center, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems Command and Control Systems Management Information Systems*, U.S. Department of the Air Force, (Hill AFB, Utah, 2003), 14-3.

[7] U.S. Air Force, *Air Force Basic Doctrine*, Air Force Doctrine Document 1 (Washington DC: Department of the Air Force, September 1997), 54.

Interconnection of C2 Terms

The three terms—system, interoperability and integration—are interconnected with the function of C2. The Services organize personnel, command structures, facilities, equipment and procedures into a C2 system. Secondly, the Services develop distinct C2 systems that internally are integrated. And finally, the Services develop interoperability into their C2 system so it can operate with the systems of the other Services.

Why are the interconnections important? Recall the earlier discussion in Chapter 2 about the OODA loop as a decision-making model for the commander. But decision-making in a combat environment is too complex to describe in a single model. The strength of C2 is the capability to enable combat decision-making. In fact, "Boyd transforms the OODA loop from a model of human behavior into a conception for human interaction in war. As such his ideas encompass both the process of command and control and the ideas behind maneuver warfare. More importantly, Boyd offers broader conceptualizations of how to think about modern military operations."[8] C2 is more than the OODA loop or the decisions of individual commanders, but a way to think more broadly across military operations.

In fact, war is more than a single decision to engage in combat, but rather a series of decisions competing against an enemy at the tactical, operational and even strategic levels. Therefore, any decision-making model like the OODA loop must adapt to an environment of multiple, simultaneous decisions. As Major Polk points out, "An organization risks failure by inappropriately responding at every level to the competing and often overlapping OODA phases. In response, Boyd counsels that the time needed to

[8] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999, 38.

complete an OODA cycle increases with each ascending level in the decision-making hierarchy as the number of events one must consider correspondingly increases."[9] Clausewitz also recognized the dilemma of time and tempo as it relates to decision-making, "Any given situation requires that probabilities be calculated in the light of circumstances, and the amount of time available for such calculation will depend on the pace with which operations are taking place."[10]

Naval Doctrine Publication (NDP) 6 states, "The essential lesson of the decision and execution cycle is the absolute importance of generating tempo."[11] Tactically, the friendly and enemy decision cycles are occurring at the same time, in competition against each other, both generating actions in the battlespace as depicted in Figure 4.1. The goal is to gain situational awareness, issue orders and execute ahead of the same actions by the enemy. Faster decision-making, irrespective of the enemy, will not automatically generate tempo, but making decisions faster relative to the enemy's decisions will. These competing decision cycles apply to commanders at the operational and theater level, except they are significantly more complicated because of the exponential increase in the number of decisions and the subsequent actions in the battlespace.

[9] Ibid, 20.

[10] Carl Von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Peret (Princeton, NJ: Princeton University Press, 1989), 85.

[11] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 60.

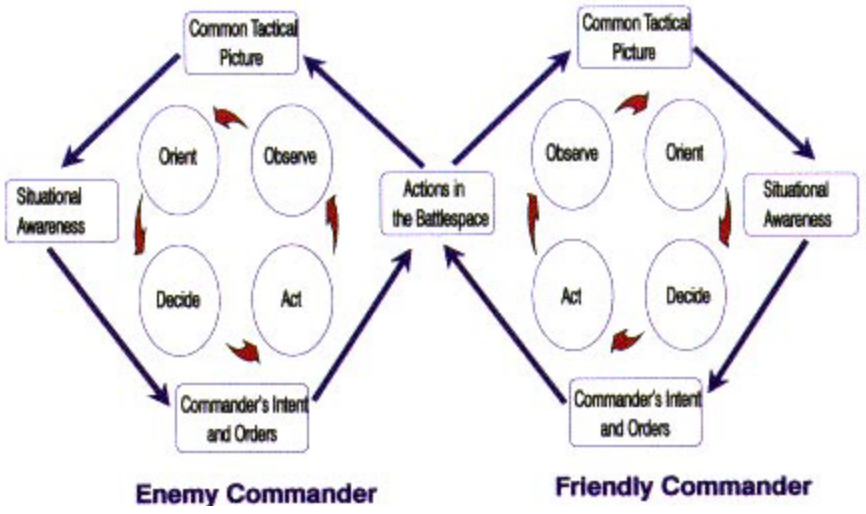

Figure 4-1. Interaction of Friendly and Enemy Decision and Execution Cycles[12]

"To be effective, our command and control, both the process and the system, must be able to cope with the effects of uncertainty and time."[13] And "the resulting tension between coping with uncertainty and racing against time presents the fundamental challenge of command and control."[14] In two crucial ways, C2 enables the commander to make timely, accurate decisions faster than the enemy and thereby create tempo. First, recall the OODA loop model (Figure 2.4) in Chapter 2 had the overarching arrow labeled Implicit Guidance and Control. This explains the fact that Commanders provide their intent and direction. Currently Joint and Service doctrine explain the same concept in several different names—mission command, mission control, maneuver warfare or decentralized execution. The OODA loop model depicts this concept as Commander's Intent and Orders. But this is more than a step in the cycle, but rather an inherent aspect

[12] Ibid.

[13] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 51.

[14] U.S. Marine Corps, *Command and Control*, Marine Corps Doctrine Publication 6 (Washington DC: Department of the Navy, October 4, 1996), 57.

of decision-making and C2 that remains the same even if all the Services use a single Joint C2 system. The senior commander gives subordinate commanders and subordinate units the flexibility to use their initiative to complete the mission. And the subordinate commanders understand the commander's direction and intent as they execute the mission. Used effectively, the potential benefits of creating tempo through initiative outweigh the risks of misinterpretation, inaction or delay waiting for direction.

The second way C2 enables faster decision-making is by helping the commander cope with uncertainty through information management (IM) and knowledge management (KM). Each is slightly different but mutually supportive, therefore both need further explanation. According to Field Manual (FM) 6-0, *Mission Command*, information management is defined as "the science of using procedures and information systems to collect, process, store, display, disseminate, and protect data, information, and knowledge products."[15] By definition, IM is more than the converting data into information. It also includes all the tasks of increasing the usefulness of information. Additionally, KM is defined as "the art of creating, organizing, applying, and transferring knowledge to facilitate situational understanding and decision-making."[16] As such, IM and KM are inherent in all three elements of C2—people, systems and processes. For example, C2 systems collect, store and protect information; C2 processes organize knowledge; and C2 operators disseminate, display and share the information and knowledge.

[15] U.S. Army, *Mission Command: Command and Control of Army Forces,* Field Manual 6-0 (Washington DC: Department of the Army, August 11, 2003), A-2.

[16] Ibid, A-8.

Recall the Cognitive Hierarchy model (Figure 2.5) from Chapter 2, and the explanation of how data progresses to information, then knowledge and finally understanding. Figure 4.2 is a different model that shows how IM and KM assimilate and blend with the cognitive hierarchy. Also recall that people are the most important element of the C2 system. First C2 operators apply meaning to data, turning data into information. Then commanders apply judgment to information, turning it into knowledge. By reducing uncertainty, information and knowledge help commanders make decisions.

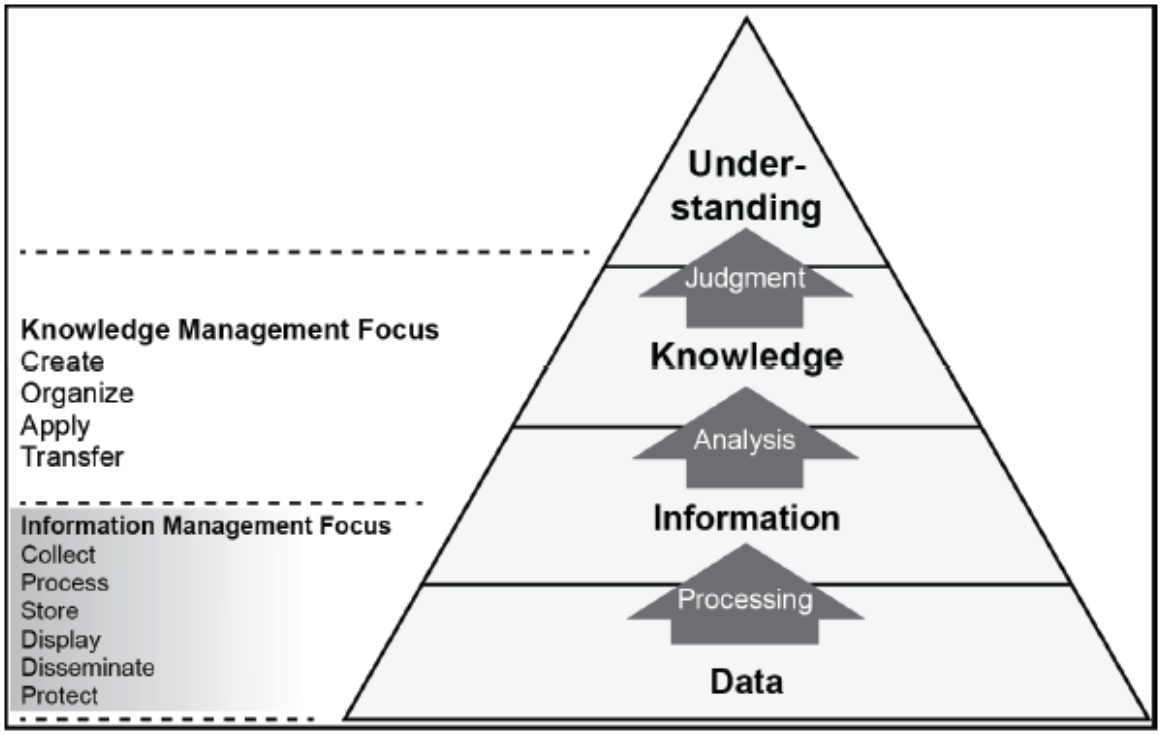

Figure 4.2. Expanded Cognitive Hierarchy Model.[17]

However the more important point is that IM/KM help reduce uncertainty for more people throughout the larger C2 structure and across a longer time. Advances in

[17] U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual 6-0 (Washington DC: Department of the Army, August 11, 2003), A-1.

technology—specifically computing power, speed, storage and bandwidth—have resulted in corresponding improvements in IM and KM even before the concepts were developed and included in doctrine. As previously stated, the speed of friendly decision-making is most critical when compared relative to the speed of enemy decision-making. While IM and KM reduce uncertainty, a commander should not expect to achieve complete certainty in order to make a decision. Clausewitz also recognized the uncertainty associated with war, "The art of war deals with living and with moral forces. Consequently, it cannot attain the absolute, or certainty; it must always leave a margin for uncertainty, in the greatest things as much as in the smallest."[18] It will take varying amounts of time to progress through the cognitive hierarchy, but the amount of time cannot be reduced to zero. Therefore effective interaction of the three elements of the C2 system is the key to fast, accurate decision-making.

How is this relevant?

What makes all of this discussion important to the hypothesis? And why does it matter to C2? If "one of the basic uses of information is to help create situational awareness as the basis for a decision,"[19] then how does C2 create situational awareness? As AFDD 1 states, "Despite impressive gains in data exploitation and automated decision aids, a single person cannot achieve and maintain detailed situational awareness when fighting a conflict involving many simultaneous engagements taking place throughout a

[18] Carl Von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Peret (Princeton, NJ: Princeton University Press, 1989), 86.

[19] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 88.

large area."[20] The challenge for C2 is to create shared situational awareness not just for the individual commander, but for every commander and operator across the entire C2 structure.

As previously indicated, Boyd considered the Orientation step as the most important. But he further theorized: "With proper orientation, individuals and organizations may develop a common shared understanding (CSU) of operational situations."[21] Joint doctrine defines a common operational picture (COP) as, "A single identical display of relevant information shared by more than one command that facilitates collaborative planning and assists all echelons to achieve situational awareness."[22] Boyd not only advocated the importance of his OODA loop decision-making model, but he also advocated the importance of a COP for military operations due to the complex environment where multiple, simultaneous, and continuous OODA loop decision cycles are involved. "The orientation process shapes the character of the current decision and execution cycle; in turn, present cycles shape the character of future cycles."[23]

If "the role of IM is to provide a timely flow of relevant information that supports all aspects of decision making"[24] and the goal of C2 "is to provide the ability to make

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[20] U.S. Air Force, *Air Force Basic Doctrine*, Air Force Doctrine Document 1 (Washington DC: Department of the Air Force, September 1997), 29-30.

[21] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999, 23.

[22] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 15, 2012), 56.

[23] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 19.

[24] U.S. Joint Chiefs of Staff, *Joint Task Force Headquarters*, Joint Publication 3-33 (Washington DC: Joint Chiefs of Staff, July 30, 2012), D-1.

decisions and execute those decisions more rapidly and effectively than the adversary,"[25] then it is predictable that a COP is the preferred method described in the doctrine of each of the four Services. "People not only think in terms of images, they also understand things best as images and are inspired the most by images. Images also can describe the military challenges we face, as well as their solutions."[26]

Recall from Chapter 2 the discussion of vertical and horizontal interactions inherent in C2 structures. Commanders and staffs "use the COP as a tool for developing knowledge and understanding"[27] and therefore to create shared understanding. The COP is the single most important enabler of vertical and horizontal interactions and of shared understanding. AFDD 6-0 explains, "Both vertical and horizontal information flow exchange data that, when fused in a timely manner, becomes integrated information to provide the framework for the commander to make the best possible decision."[28]

Recall from Chapter 3, C2 systems of the Service components form the basis for a JTF C2. "The C2 system supports the commander by providing COP-related information that sustains the commander's situational understanding, by developing products supporting his decision-making, and by preparing and disseminating execution information to implement his decisions."[29] But the C2 systems of the Services are either domain specific (e.g. Air Force systems for the air domain, Navy for maritime, and Army

[25] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), III-3.

[26] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 38.

[27] U.S. Army, *Mission Command*, Army Doctrine Publication 6-0, Change 1 (Washington DC: Department of the Army, September 10, 2012), A-3.

[28] U.S. Air Force, *Command and Control*, Air Force Doctrine Document 6-0, Change 1 (Washington DC: Department of the Air Force, July 28, 2011), 20.

[29] U.S. Army, *Mission Command: Command and Control of Army Forces*, Field Manual 6-0 (Washington DC: Department of the Army, August 11, 2003), 6-32.

for land) or mission specific (e.g. USMC for amphibious operation). When the Service C2 system (Air Force) becomes the C2 system for the functional component (JFACC), the visual COP display is limited to only these two command structures. The COP display for the air domain is separate and distinct from the other domains. The other Service and functional commands have a similar construct. So the only way to share a distinct COP with another command becomes a function of adding a stand-alone display. This construct hampers vertical and horizontal coordination and shared understanding across the Service and functional commands.

According to Joint doctrine, JTF duties "may include the following: Determining the C2 and support relationships for the proper employment of assigned and attached forces for accomplishing assigned missions and keeping the established authority informed…"[30] However, the only option for the JFC is to use a conglomeration of the separate C2 systems with separate COPs for each domain, instead of a single C2 system that can display a single COP that integrates all domains. Because of this multi-COP construct, functional commanders, staffs and C2 operators are forced to fuse information between the distinct C2 systems through a combination of mental, verbal and/or manual techniques as a part of their IM and KM and decision making processes.

In order to compensate for the lack of a cross-domain COP, the Services adapt their systems to be more *interoperable* with the systems from the other Services. In contrast, the Services *integrate* the subsystems of their respective C2 systems. Before the budget constraints of the current fiscal environment, the Services had larger sums of money, but they did not develop a single C2 system with a cross-domain COP. Instead

[30] U.S. Joint Chiefs of Staff, *Joint Task Force Headquarters*, Joint Publication 3-33 (Washington DC: Joint Chiefs of Staff, July 30, 2012), II-6.

they increased the quantity and quality of their Service-specific C2 systems, relying on interoperability instead of integration. In fact, a corollary thesis could argue that during the period of large budgets, the Service C2 systems became more distinct, unique and less Joint. This thesis argues this trend will likely continue unless the DoD directs a paradigm shift from a Service-centric approach to a Joint approach.

The warfighting trend continues toward 'Jointness' both as a Joint force and in Joint operations. By definition, a Joint force consists of forces of two or more Services. As outlined in Joint Publication 1, "The Armed Forces of the United States are most effective when employed as a Joint force. This 'comprehensive approach' involving all participating organizations within an operational area requires the JFC to understand the capabilities, limitations, and mandates of those organizations involved…"[31] Further, Joint Publication 3-0 describes Joint operations as "military actions conducted by Joint forces and those Service forces employed in specified command relationships with each other, which, of themselves, do not establish Joint forces."[32]

As the DoD looks to develop the next generation of C2 systems, the recently published Capstone Concept for Joint Operations (CCJO) outlines the future environment, a future operational concept, and implications for the Joint force. Many of the ideas in the CCJO address how C2 must adapt. "Digital technology is also profoundly altering command and control within our own military and between military and civilian leaders."[33] And in a more connected world, "the dimensions of any

[31] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), II-11.

[32] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), I-1.

[33] U.S. Joint Chiefs of Staff, *Capstone Concept for Joint Operations*, (Washington DC: Joint Chiefs of Staff, September 10, 2012), 3.

particular security challenge may not align with existing boundaries or command structures."[34] The CCJO acknowledges, "The strength of our Joint Force has always been its ability to combine unique Service capabilities to project decisive military force. The concept of globally integrated operations aims to accelerate and expand how the Joint Force musters decisive force."[35] The CCJO identifies changes to C2 operating concepts such as, "A new generation of digital collaboration technology enables us to realize mission command in even more powerful ways. Mobile devices with reach-back to network-based Services will allow distributed commanders and staffs to collaborate as though co-located."[36] The future environment and operating concept have far-reaching implications for C2 that are particularly relevant to this thesis, including the development of "…portable, cloud-enabled command and control technologies. These technologies should allow commanders and others to access imagery and other situational information to develop, share, and reconcile operational pictures."[37] Finally, the CCJO states, "Interoperability is the critical attribute that will allow commanders to achieve the synergy from integrated operations this concept imagines. Within Joint Forces, interoperability should be widespread and should exist at all echelons, among Services and extend across domains."[38] On the contrary, this thesis contends the critical attribute to achieve the CCJO's future vision of C2 is integration, not interoperability. The

[34] Ibid.

[35] Ibid, 4.

[36] U.S. Joint Chiefs of Staff, *Capstone Concept for Joint Operations*, (Washington DC: Joint Chiefs of Staff, September 10, 2012), 5.

[37] Ibid, 9.

[38] Ibid, 10.

Services' distinct C2 systems cannot reach a sufficient level of interoperability to have the affects outlined in the CCJO, while an integrated C2 system can.

CHAPTER 5:

Recommendations and Conclusion

Why develop a single C2 system?

> Command and control (C2) is an essential element of the art and science of warfare. No single specialized function, either by itself or combined with others, has a purpose without it.[1]

Due to constrained budgets, the Department of Defense (DoD) will be forced to implement budgeting methods that either save money or decrease capacity while maintaining combat capability. If the premise is true that command and control is a force multiplier, this thesis recommends that DoD allocate time, effort and funding on a C2 capability that in fact multiplies the capability of Joint forces. The solution ultimately depends on DoD directing the development of a single Joint C2 system that is then integrated across the Services. Otherwise the Services will continue to define their Service-specific requirements and develop and fund separate systems.

The strength of the hypothesis for a single C2 system is derived by answering 'why' and 'how'. The discussion of 'why' is based on three points. As outlined in this thesis, C2 is an essential function for all Joint operations and therefore requires an equivalent level of focus on the required C2 capabilities. The current construct does not solve the core issue and never will; it is a vertical solution to a horizontal problem. Instead, a new construct will have positive implications across associated doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) solution areas.

The principles and doctrine that apply to the current construct of separate Service systems will be applicable to a construct of a single Joint C2 system. This thesis explained many terms including: command, control, command and control, systems, interoperability and integration. It also explained several concepts including: OODA loop, cognitive hierarchy, decision-making, information management, knowledge management and mission command (and associated terminology). These principles are relevant today, but more importantly will continue to be relevant under the construct of a single Joint C2 system.

Boyd recognized that "shared understanding of the problem allows individuals at all levels to observe and orient simultaneously within the organization"[1] regardless of the C2 system. The distinction is a single Joint C2 system promotes initiative by enabling a shared understanding simultaneously across functional and Service component command structures throughout the entire JTF structure, while separate C2 systems do not. Further, "for Boyd, the key to rapid action is a system of communication that exploits lower-level initiative while realizing higher-level intent,"[2] enabling decision-making and promoting mission command at all levels of command.

The Goldwater-Nichols Act directed actions to remove the institutional barriers and improve Jointness, yet the Services still operate in stovepipes as a result of their Title X responsibilities to organize, train and equip. The functional and Service component commanders use their distinct C2 structures and systems to conduct operations in their domains. Typically, the functional component commanders seek objectives to gain and

[1] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999, 52.

[2] Ibid, 51.

maintain domain superiority. To accomplish this task, the Services developed domain-specific C2 systems along Service requirements to accomplish this task. As such the separate C2 systems have limited interoperability across other domains. But "future warfare will take place in an expanded battlespace, characterized by rapid, simultaneous, and violent actions across all dimensions—air, land, sea, undersea, space, time, and the electromagnetic spectrum."[3] As combat operations become more complex, actions in one domain have effects in other domains often simultaneously. This requires increasingly higher levels of coordination. Conversely for the Joint force, distinct Service C2 systems are vertical solutions to a larger horizontal cross-domain problem.

The volumes of Service and Joint doctrine describe the decisive nature of C2 as a synchronizing function. Unquestionably, C2 will be even more important to synchronize Joint operations in an increasingly dynamic and complex future environment. And C2 principles "allow maximum freedom of decision and action for subordinates; create, maintain, and disseminate the common operational picture; use common doctrinal procedures; and provide flexibility and adaptability."[4] Alone, a computer can process many applications and a network combines many computers, together they enable the ability to synchronize processes and functions. Similarly, a Joint C2 system better enables the Service and component commanders to synchronize their efforts across the larger JTF command structure.

The final aspect of why DoD needs to develop a single Joint C2 system, is the implications, or the second order effects it will create. Improving Joint operations is a

[3] U.S. Navy, *Naval Command and Control*, Naval Doctrine Publication 6 (Washington DC: Department of the Navy, May 19, 1995), 4.

[4] Robert B. Polk, "A Critique of The Boyd Theory – Is It Relevant to the Army," (Fort Leavenworth, KS, U.S. Army Command and General Staff College, 1999), 55.

persuasive argument. Cynics will not only argue against the perceived benefits to Joint operations, but might also argue that a single system is reorganization for the sake of reorganization or use the 'if it's not broke, don't fix it' argument. These arguments lack vision and narrowly focus on a simple solution instead of a better solution. For example, currently *doctrine* uses existing C2 structures to establish the JTF *organizational* structure while relying on the Services' separate C2 systems to provide the *materiel* and *facilities* solutions. In contrast, a single system will have positive implications across associated doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) solution areas. The following excerpt from Joint Publication 3-33 clearly highlights several examples of second order effects on doctrine, organization, training, leadership and education and personnel as a result of the separate C2 systems:

> In some cases, the CCDR may request a deployable team from USTRANSCOM's JECC to help the designated Service HQ transition to the JTF HQ, which the CCDR and CJTF would then augment with additional Service functional experts. DoD relies primarily on Service component HQs to adapt with little or no notice into a JTF HQ, often under crisis action planning (CAP) conditions. However, the newly designated JTF HQ typically will require additional resources that are not organic to the core Service HQ. Examples include Joint C2 equipment and training and augmentation from the JTF's Service components. The CJTF and staff should plan for the time required to integrate new personnel and capabilities expected to be involved in the operation. Once the JTF HQ is established, it takes time to receive, train, and integrate new members and then to begin functioning as a cohesive HQ with common processes, standards, and procedures.[5]

A single Joint C2 system resolves many of the disconnected effects on the elements of DOTMLPF. A single Joint C2 system requires the entire JTF, including the

[5] U.S. Joint Chiefs of Staff, *Joint Task Force Headquarters*, Joint Publication 3-33 (Washington DC: Joint Chiefs of Staff, July 30, 2012), II-1.

functional and Service component HQs and lower command echelons, to use the same system. Each echelon will use the same systems tailored to fit the size and scope of their organization, independent of domain. As a result doctrine, training and education will be standardized for all personnel. C2 operators and personnel of any Service will be more compatible across organizations and more quickly integrated.

How to develop a single C2 system?

Commanders often share a saying with their subordinates: "Don't just bring me problems, bring me the solutions too." That is to say, identifying that a problem exists is easier than isolating the exact problem and figuring out the specific solution. And once the solution is determined, the decision to commit resources to implement the solution can be challenging. Therefore this thesis would be incomplete without also including discussion on 'how' to implement the recommended solution. "In 2003, DoD implemented the Joint Capabilities Integration and Development System (JCIDS)—a requirements generation system intended to prioritize and ensure that the most essential needs of the warfighter are met."[6] First, to implement the recommendation of a single Joint C2 system, the combatant commands (CCMD) need to increase their staffs directorates to more effectively focus on the JCIDS process specifically on three critical aspects of the process—requirements, funding and acquisition strategy.

Requirements Definition

A combatant commander (CCDR) executing his role as the Joint Force Commander (JFC), is the principal warfighting commander. JFCs execute Joint

[6] U.S. Government Accountability Office, *GAO-08-1060, Defense Acquisitions, DOD's Requirements Determination Process Has Not Been Effective in Prioritizing Joint Capabilities*, GAO Report to the Committee on Armed Services, U.S. Senate, (Washington DC, 2008), 1.

operations. The JFC "has the authority and responsibility to effectively organize, direct, coordinate, and control military forces to accomplish assigned missions."[7] However using the JCIDS process, CCDR's "needs are expected to be determined from a Joint capabilities perspective, rather than from an individual Service or program perspective, which can lead to stovepiped solutions."[8] Organizationally, the CCDR has the authority and responsibility to establish C2. However, a CCDR does not have the staff to affect the process and as a result he/she is relegated to using the C2 systems the Services develop. According to the *United States Government Accountability Office (GAO) Report to the U.S. Senate Committee on Armed Services*, "the JCIDS process has not yet met its objective to identify and prioritize warfighting needs from a Joint capabilities perspective. Instead, capabilities continue to be driven primarily by the individual Services with little involvement from the COCOMs…" JP 3-0 highlights the dilemma,

> The perceived benefits of 'Jointness' do not occur naturally just by virtue of C2 relationships. The integration necessary for effective Joint operations requires explicit effort, can increase operational complexity, and will require additional training, technical and technological interoperability, liaison, and planning. Although effectiveness typically is more important than efficiency in Joint operations, the JFC and component commanders must determine when the potential benefits of Joint integration cannot compensate for the additional complicating factors. Synergy is a means to greater operational effectiveness, not an end in itself.[9]

In the case of C2 systems, it appears the CCMDs cope with more operational complexity because the effort (due in part to lack of staff personnel) to improve

[7] U.S. Joint Chiefs of Staff, *Joint Task Force Headquarters*, Joint Publication 3-33 (Washington DC: Joint Chiefs of Staff, July 30, 2012), IV-1.

[8] U.S. Government Accountability Office, *GAO-08-1060, Defense Acquisitions, DOD's Requirements Determination Process Has Not Been Effective in Prioritizing Joint Capabilities*, GAO Report to the Committee on Armed Services, U.S. Senate, (Washington DC, 2008), 1.

[9] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Joint Chiefs of Staff, August 11, 2011), III-5.

integration and efficiency are outweighed by the fact that separate C2 systems are moderately effective.

"Fundamentally Joint forces require high levels of interoperability and systems that are conceptualized and designed with Joint architectures and acquisition strategies. This level of interoperability reduces technical, doctrinal, and cultural barriers that limit the ability of JFCs to achieve objectives."[10] In 2003, the DoD established JCIDS "as the process used by the Joint Requirements Oversight Council (JROC) to fulfill its advisory responsibilities to the Chairman of the Joint Chiefs of Staff in identifying, assessing, validating, and prioritizing Joint military capability requirements."[11] "The process was intended to move the department away from a Service-centric, stovepiped approach to a Joint approach that helps ensure that COCOMs are provided the capabilities needed to carry out military operations."[12] Additionally, JCIDS outputs are "used to facilitate Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) changes, to drive the Defense Acquisition System (DAS), and to inform the Planning, Programming, Budgeting, and Execution (PPBE) processes…"[13]

The JROC premise submits an annual report detailing the combatant command requirements. The report contains "a consolidation of the integrated priority lists (IPLs)

[10] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), I-2.

[11] U.S. Joint Chiefs of Staff, *CJCS Instruction 3170.01H: Joint Capabilities Integration and Development System*, (Washington DC: Joint Chiefs of Staff, January 10, 2012), 1.

[12] U.S. Government Accountability Office, *GAO-08-1060, Defense Acquisitions, DOD's Requirements Determination Process Has Not Been Effective in Prioritizing Joint Capabilities*, GAO Report to the Committee on Armed Services, U.S. Senate, (Washington DC, 2008), 20.

[13] U.S. Joint Chiefs of Staff, *CJCS Instruction 3170.01H: Joint Capabilities Integration and Development System*, (Washington DC: Joint Chiefs of Staff, January 10, 2012), 2.

from the Combatant Commands; the CJCS views on the consolidated lists; a description of the extent to which the most recent future-years defense program addresses the requirements on the consolidated lists; and a description of the funding proposed in the President's budget to address each deficiency."[14] However, "before a weapon system program is approved to begin system development, the sponsor is required to submit a capability development document (CDD)—which defines a specific solution as identified in the analysis of alternatives—through JCIDS for approval by the JROC."[15]

In May 2012, the Undersecretary of Defense for Acquisition Technology and Logistics (AT&L) approved the "Joint Command and Control (C2) Capability Analysis of Alternatives (AoA) conclusions, recommendations, and post-AoA activities to implement the Joint C2 sustainment and modernization strategy."[16] The associated draft Capability Development Document (CDD) "defines the requirements and capability development strategy through which Joint C2 will integrate existing and emerging command and control capabilities into a single, flexible, enterprise-based architecture supporting Joint Force Commanders (JFC), and their functional and Service component commanders down to unit level commanders."[17] The CDD outlines seven capability gaps and four Alternative solutions using the Global Command and Control System (GCCS) as the core software system.[18]

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[14] U.S. Joint Chiefs of Staff, *CJCS Instruction 5123.01F: Charter of the Joint Requirements Oversight Council*, (Washington DC: Joint Chiefs of Staff, January 10, 2012), A-2.

[15] U.S. Government Accountability Office, *GAO-08-1060, Defense Acquisitions, DOD's Requirements Determination Process Has Not Been Effective in Prioritizing Joint Capabilities*, GAO Report to the Committee on Armed Services, U.S. Senate, (Washington DC, 2008), 5-6.

[16] U.S. Joint Chiefs of Staff, *Joint Command and Control (C2) Capability Development Document (CDD)*, (Washington DC: Joint Chiefs of Staff, January 31, 2013), 14.

[17] Ibid, ii.

[18] Ibid, 11-12.

C2 Capability Gaps

1	Inability to collaboratively construct and actively manage strategic campaign and operations plans and orders IAW campaign strategies and changing conditions.
2	Inability to manage the creation (including access to all necessary/desirable data sources) and timely and organized updating of SA information.
3	Inability to collaboratively plan and synchronize the timely employment of forces.
4	Inability to make releasable COP track information available and accessible to authorized mission partners on separated network domains.
5	Inability to quickly and securely pass non-COP operations and planning information to and receive information from authorized mission partners on separated network domains without requiring manual re-entry.
6	Inability to provide an integrated, interoperable Joint C2 information environment.
7	Inability to effectively integrate ISR assets in support of C2 across National, Service and Component boundaries.

Joint C2 Alternatives

• Alternative 1 – Status Quo (SQ): No GCCS Family of Systems (FoS) modernization beyond President's Budget-11 (PB-11). The SQ capabilities baseline includes capabilities already fielded and any enhancements already programmed in the PB-11

• Alternative 2 – GCCS FoS Upgrade: Follow-on development and integration of GCCS FoS to meet NECC [Net Enabled Command and Control] CDD requirements. Modernization beyond the SQ capabilities can be pursued conceptually without constraint.

• Alternative 3 – Best of Breed: Select a single GCCS FoS variant that could be modified and/or upgraded to become the standard DOD system to which the Services or other users migrate. The current GCCS-J variant is assumed to be adopted and/or adapted by all and modernized as necessary to satisfy Joint and Service-unique operational-level C2 capability needs.

• Alternative 4 – Total Custom Development: Undertake a new start development effort with the functionality developed by DOD. A new Joint C2 program would be initiated similar in scope and program structure to the NECC program as it existed in FY09.[19]

[19] U.S. Joint Chiefs of Staff, *Joint Command and Control (C2) Capability Development Document (CDD),* (Washington DC: Joint Chiefs of Staff, January 31, 2013), 13.

The Joint C2 (JC2) capability is the Joint Staff/J6 effort to develop a single Joint C2 system. From the four alternatives, the J6 selected Alternative 2 as the solution for JC2. From a requirements perspective, Alternative 4, not Alternative 2, is the superior solution for the development of a JC2 capability. Alternative 2 will update the Global Command and Control System (GCCS) Family of Systems (FOS) which includes GCCS-Joint (GCCS-J), GCCS-Integrated Imagery and Intelligence (GCCS-I3), and its Service variants to include: GCCS-Army, GCCS-Air Force, Theater Battle Management Core System (TBMCS), Deliberate and Crisis Action Planning and Execution Segments (DCAPES), Joint Environmental Toolkit (JET), and GCCS-Maritime and deliver those through a federated Family of Programs (FoP).[20] The GCCS FoP is the only software that will be integrated in the JC2 capability. However, the FoP constitutes only a small portion of the Service C2 systems. Besides GCCS, the Services will be responsible to develop all other portions of their C2 systems. As outlined, Alternative 2 will result in C2 systems that will essentially still be Service-unique and distinct. According to the GAO Report, COCOM officials "indicated that to be successful in getting a need addressed, they have to build a coalition with one or more Services that may have similar needs. At the same time, the military Services continue to drive the determination of capability needs…"[21] Comparison between the alternatives shows Alternative 4, not Alternative 2, is the only solution that requires the development of a single C2 system.

[20] U.S. Joint Chiefs of Staff, *Joint Command and Control (C2) Capability Development Document (CDD)*, (Washington DC: Joint Chiefs of Staff, January 31, 2013), D-1.

[21] U.S. Government Accountability Office, *GAO-08-1060, Defense Acquisitions, DOD's Requirements Determination Process Has Not Been Effective in Prioritizing Joint Capabilities*, GAO Report to the Committee on Armed Services, U.S. Senate, (Washington DC, 2008), 15.

A Systems Approach for Requirements Definition

Moreover, Alternative 4 requires a systems integration approach. And system integration requires a systems engineering perspective. "When systems engineering is employed throughout the project, successful system integration is one of the primary outcomes. This includes requirements definition…"[22] Defining the requirements at the component-level is a fundamental first step for a single C2 system. Further, the systems engineering process has several key characteristics that will ensure integration of each of the Service C2 requirements:

- The specific desired outcome must be known, and it must be clear and unambiguous (implied in this is that the edges of the system, and thus responsibility, are clear and known);
- There must be a single, common manager who is able to make decisions about allocating available resources to ensure completion;
- Change is introduced and managed centrally;
- There must be "fungible" resources (that is money, people, time, etc.) which can be applied and reallocated as needed.[23]

"System integration is the successful putting together of the various components, assemblies, and subsystems of a system and having them work together to perform what the system was intended to do."[24] Integration is iterative and progressive, with each level of integration building from and on top of the previous level of integration."[25] As shown by Figure 5-1, a systems integration approach requires integration between components, then assemblies, then subsystems. Additionally, this approach requires testing at the

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[22] U.S. Air Force, Software Technology Support Center, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems Command and Control Systems Management Information Systems*, U.S. Department of the Air Force, (Hill AFB, Utah, 2003), 14-3.

[23] Douglas O. Norman, "Engineering a Complex System: A Study of the AOC," The MITRE Corporation, (Virginia, 2004), 3-4.

[24] U.S. Air Force, Software Technology Support Center, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems Command and Control Systems Management Information Systems*, U.S. Department of the Air Force, (Hill AFB, Utah, 2003), 14-3.

[25] Ibid, 14-5.

component, assembly and subsystem levels to ensure full integration. As such, the DoD test and evaluation organizations should be incorporated into the systems integration processes throughout the developmental cycle. "Finally, the subsystems are integrated into the complete system, which is then tested for functionality."[26]

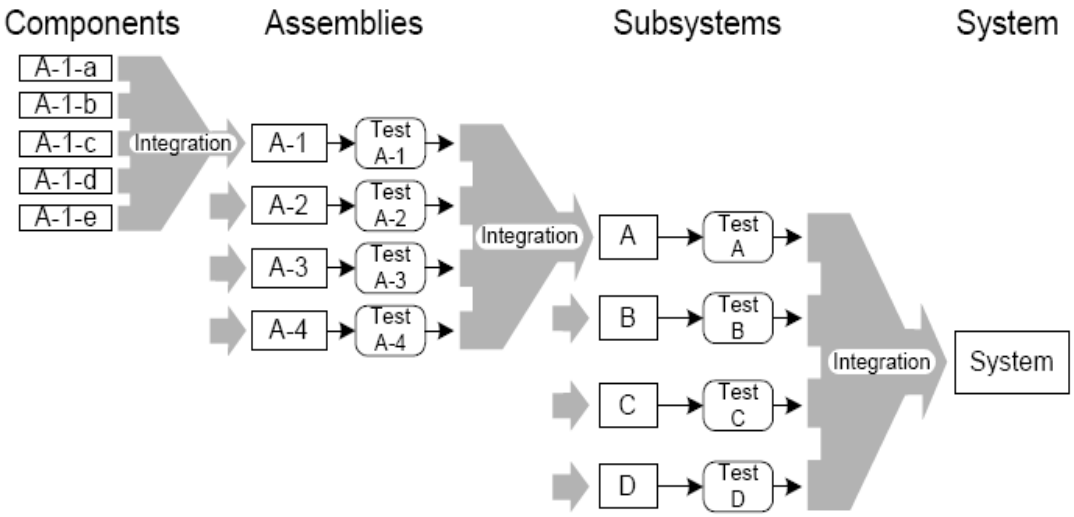

Figure 5-1. Nature of System Integration.[27]

System integration begins at the lowest level and is mostly associated with hardware and software. The reason is "these two are sometimes looked at as complete systems in and of themselves, but they cannot function independently of each other. While they may be called the hardware and software systems, in the system level view they should both be considered as elements of the real, complete system."[28] However, Figure 5-2 shows the two other elements—people and support systems. "While these

[26] U.S. Air Force, Software Technology Support Center, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems Command and Control Systems Management Information Systems*, U.S. Department of the Air Force, (Hill AFB, Utah, 2003), 14-5.

[27] Ibid.

[28] Ibid, 14-6.

other elements may not need to be in place during the development integration, they nonetheless are part of the complete system."[29]

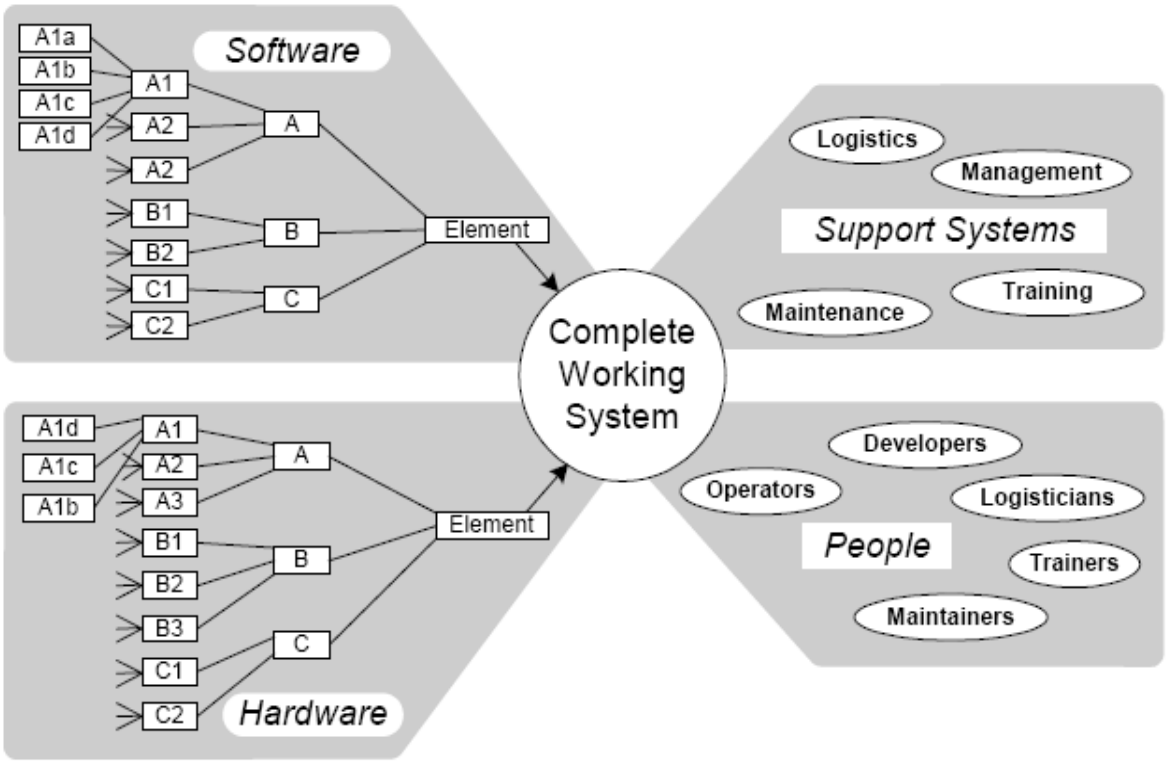

Figure 5-2. System Elements.[30]

Using a systems approach, Alternative 4 will result in hardware and software that is identical for all four Services. However, this will not restrict operations. The Services will employ a single C2 system differently. The C2 operations of each Service will train and employ to a higher level of proficiency in their particular domain. But using a systems approach that includes all the elements, the C2 operators of each Service will also be trained in every domain. For example, a C2 operator in the Navy's Maritime

[29] U.S. Air Force, Software Technology Support Center, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems Command and Control Systems Management Information Systems*, U.S. Department of the Air Force, (Hill AFB, Utah, 2003), 14-6.

[30] Ibid, 14-7.

Operations Center (MOC) will be more proficient employing C2 in the maritime domain, but will be trained in the air and land domain also. And when required during Joint operations, a C2 operator in any facility will theoretically be trained and proficient in tailoring the common operational picture (COP) display; accessing data and databases in real-time; collaborating vertically and horizontally with other units; and synchronizing military capabilities and forces across all domains.

In contrast, Alternative 2 will integrate the GCCS FoP, while the rest of the subsystems will not be integrated or may not be interoperable because there is no requirement. Since the level of integration is limited to a single software application, the Services will not integrate two critical system elements—people and support systems. By definition, interoperability is not required at any sub-level. Alternative 2 assumes the GCCS FoP is itself the interoperability between the Service C2 systems. Consequently, Alternative 2 will not solve the root problem. On the other hand, Alternative 4 will solve the root problem—Services will continue to develop distinct C2 systems and Joint commanders will be forced to use each of the distinct C2 systems during Joint operation. Further, Alternative 4, developed with a systems approach will fulfill all seven capability gaps.

Funding

In the current era of a shrinking federal budget, prudence dictates fiscal responsibility based on in-depth analysis for DoD and the Service budgets. That subject alone would be a thesis unto itself and therefore would require a corresponding level of quantitative research. Therefore this thesis will not compare and contrast the total amount of money the Services spend on C2 versus a proposed cost of a single Joint C2

system. Further, discussions about costs for weapons systems tend to be more hypothetical forecasts rather than concrete guarantees and therefore potentially inappropriate for comparison.

This thesis however does argue that the JC2 CDD has identified funding issues but not offered any solutions. In fact, the JC2 "AoA recommended reducing sustainment costs to be one of the primary objectives for the Joint C2 modernization."[31] However, the "Joint C2 Capability AoA bottom line conclusion was…that there was no conclusive evidence that any (of the sub-alternatives) could either check sustainment cost growth or lead directly to a reduction in legacy sustainment costs." [32] Unfortunately, the JC2 CDD recommends a strategy that is a mix between 'business as usual' and 'play it by ear' (italics added for emphasis):

> The AoA recommended a level of effort funding for the sustainment and modernization of Joint C2 capabilities to be *defined through the annual* OSD Sustainment and Modernization Planning Process and the *PPBE process*. This total is *inclusive of the planned investment by each of the Components* towards Joint C2 capabilities. There is *no predetermined breakdown* between O&M, R&D and procurement funding. It is expected the amount of each type of *funding will fluctuate from year to year* as sustainment costs reduce and savings are reinvested into R&D and procurement to deliver new or enhanced capabilities. *Service and Agency program offices will manage their program funding* within an aggregate appropriated to by their Service/Agency. This level of effort *funding is not expected to fully fund all Joint C2 requirements* in the near- term. It is the amount which *has been agreed to be an affordable level of investment* at the current time.[33]

This thesis argues that DoD must commit to centralized funding of C2 as a solution for the issues identified in the AoA. The selection of Alternative 2 over

[31] U.S. Joint Chiefs of Staff, *Joint Command and Control (C2) Capability Development Document (CDD)*, (Washington DC: Joint Chiefs of Staff, January 31, 2013), 13.

[32] Ibid.

[33] Ibid, 29.

Alternative 4 was not because it was a better solution. Without offering any funding data, only vaguely implying a cost saving, it appears from a funding perspective, Alternative 2 was merely a less complicated solution. The proposal did not provide any cost breakdowns for each of the Services, only stating that each Service will spend at the current forecasted amounts.

However, centralized funding will drive the appropriate organization construct that can manage the planning, requirements, development and acquisition of a Joint C2 system. To implement a centralized funding approach, this thesis offers a 'cost neutral' recommendation. DoD should direct the Services to stop funding further development of their current systems and only authorize minimal sustainment funding for the next 5 years. Then DoD should consolidate the funding from the Services and invest in the next generation of a single Joint C2 system. Finally, centralized funding is consistent with the systems engineering and system integration approaches associated with Alternative 4.

By removing the burden of funding a Joint C2 system from the Services, then DoD can move toward a Joint solution. The Services have already shown they will continue to use their budgets to develop distinct C2 systems. And without a budget to develop warfighting capabilities, the CCMD staffs have been unable to gain a consensus for development of systems using the JCIDS process. As previously outlined, Alternative 2 is a short term, and only partial, solution to the seven capability gaps.

Acquisition Strategy

To field a single C2 system, DoD will need an innovative acquisition strategy. The strategy is to create separate Joint and Service development programs in order to control the requirements and cost aspects that when brought together will be a family of

C2 systems. The centerpiece, or the core system, of the family of systems should be the single C2 system. For example, the Joint development programs could focus on operational planning and communication, while the Services development programs could focus on tactical C2 systems. This acquisition strategy is worthy of further research, but for this thesis the discussion will use planning to illustrate the idea.

If there is one most important lesson to be learned from the Joint Strike Fighter acquisition program, it is how to control the exponential increases in requirements and cost. This lesson will jeopardize the development of a Joint C2 system. Combining all the Service C2 systems (only briefly outlined in Chapter 2) into a single development program will create a substantial amount of requirements. Using an acquisition strategy that maps outs a family of C2 systems will separate the requirements that are Joint from those that are Service specific. Further, this strategy will establish a priority for funding and development of each individual program. And finally, this strategy will allow separate, smaller and more cost effective spiral upgrades and sustainment of each family of systems versus the upgrade and sustainment of one very larger, complex C2 program.

This thesis has argued C2 is inherent to Joint operations. As such the development of a single system to command and control Joint operations should be the core system of a larger family of systems. Marine Corps Doctrine Publication (MCDP) 6, *Planning*, states "Planning is an essential and significant part of the broader field of command and control."[34] Using this same acquisition strategy, one of the separate C2 programs could be the development of a Joint planning system. Recall from Alternative 2 of the JC2 CDD, one of the systems included in the solution was the Deliberate and

[34] U.S. Marine Corps, *Planning*, Marine Corps Doctrine Publication 5 (Washington DC: Department of the Navy, July 21, 1997), 11.

Crisis Action Planning and Execution Segments (DCAPES). A logical recommendation would be to develop a Joint planning system separate from the Joint C2 system outlined in this thesis.

The validity of this recommendation is evidenced by the relationship between planning and C2. "The fundamental object of command and control is also the fundamental object of planning—to recognize what needs to be done in any situation and to ensure that appropriate actions are taken."[35] This thesis has outlined several aspects of command and control that are also aspects of planning: decision-making, shared situational awareness, and mission command. Marine Corps Doctrine Publication 6 states, "Since decision-making is central to C2, planning must contribute to effective decision-making."[36] Finally, two functions of planning are: develop a shared situational awareness; and support the exercise of initiative.[37] Using an acquisition strategy to develop a family of systems, the DoD should develop a Joint C2 system for operations centers as the core system and a Joint planning system as a support system.

Final Conclusion

Military operations will continue trending toward increasing levels of "Jointness." In order to fight more jointly, the Services must commit to develop cross-domain capabilities. The Services' primary responsibility is to maintain dominant capabilities in their respective domains. But DoD must also develop capabilities and forces that have effects in multiple domains. This thesis showed the fundamental importance and inherent

[35] U.S. Marine Corps, *Planning*, Marine Corps Doctrine Publication 5 (Washington DC: Department of the Navy, July 21, 1997), 12.

[36] Ibid, 14.

[37] Ibid, 15-16

nature of command and control to Joint operations. Currently, the Services have distinct and separate C2 systems. And those C2 systems provide situational awareness that supports the commander's decision-making. But the situational awareness does not translate between the systems and throughout the Joint C2 structures. It is a vertical solution to a horizontal problem that the Services mitigate with 'interoperability'. However, interoperability between the Service C2 systems only addresses the symptom, while integration addresses the root problem. The Joint Force Commander needs a single C2 system to integrate all domain capabilities into Joint operations. Without Joint advocacy and funding, the JCIDS acquisition process will not support the recommendation for a single Joint C2 system. Instead, the Services will continue to develop Service-centric systems.

The broader conclusion is twofold. First, this thesis does not suggest that a single C2 system is simply a solution for a more integrated combat system. Rather, a single Joint C2 system is a more comprehensive solution for the DoD. This thesis argued the primary requirement to develop a single C2 system is the warfighting function of the Combatant Commands. Besides warfighting, a single Joint C2 system will have positive affects across the range of military operations including humanitarian assistance, disaster relief, small localized contingencies, regional conflict and major theater war. Additionally, a single C2 system not only applies to the discussions of the land, maritime and air domains, but also applies to the space and cyberspace domains not discussed.

Secondly, a single Joint C2 system serves as a less complicated interface for DoD and other agencies. Other agencies only need to interface with a single C2 system instead of interfacing with each of the different Service C2 systems. This concept has greater

potential. A single C2 system can include other government and non-government agencies resulting in a whole of government solution that supports the concepts of unified action and unity of effort. According to Joint Publication 1, "Unified action synchronizes, coordinates, and/or integrates Joint, single-Service, and multinational operations with the operations of other USG departments and agencies, nongovernmental organizations (NGOs), intergovernmental organizations (IGOs) (e.g., the United Nations [UN]), and the private sector to achieve unity of effort."[38] Further, "all CCDRs are in pivotal positions to facilitate the planning and conduct of unified actions in accordance with the guidance and direction received from the President and Secretary of Defense in coordination with other authorities (i.e., multinational leadership)."[39] In conclusion, a single Joint C2 system provides a critical capability for Combatant Commanders to execute their mission and responsibilities in their respective theaters of operation.

[38] U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington DC: Joint Chiefs of Staff, March 25, 2013), II-7.

[39] Ibid, II-8.

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VITA

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